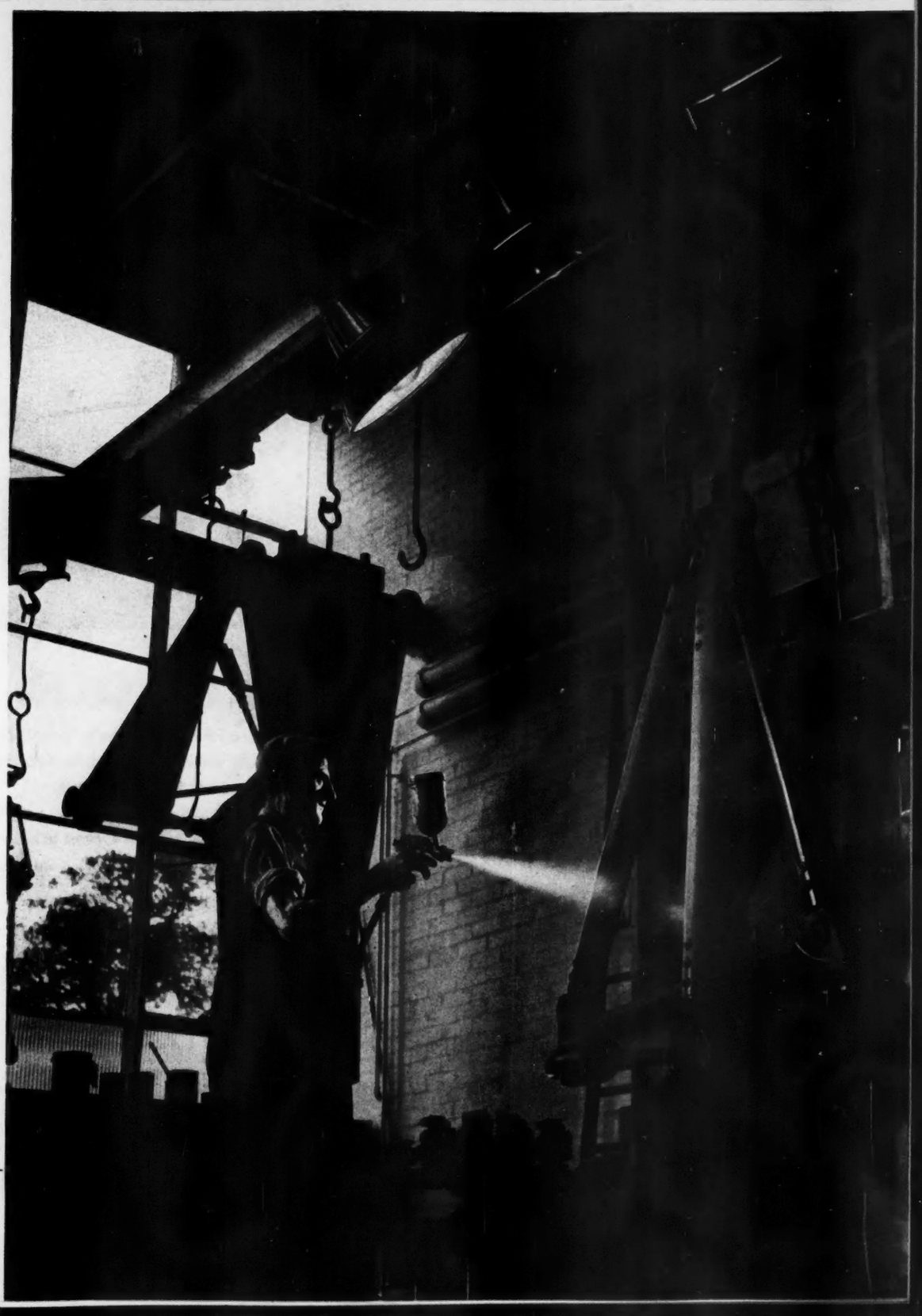
ENGINEERING



Product Profile:
The Powermaster Packaged Boiler

Helping Engineers Gain Independence

A New Approach to Strength of Materials

Launching Black Knight Without Fail

Combustion Study at Supersonic Speeds

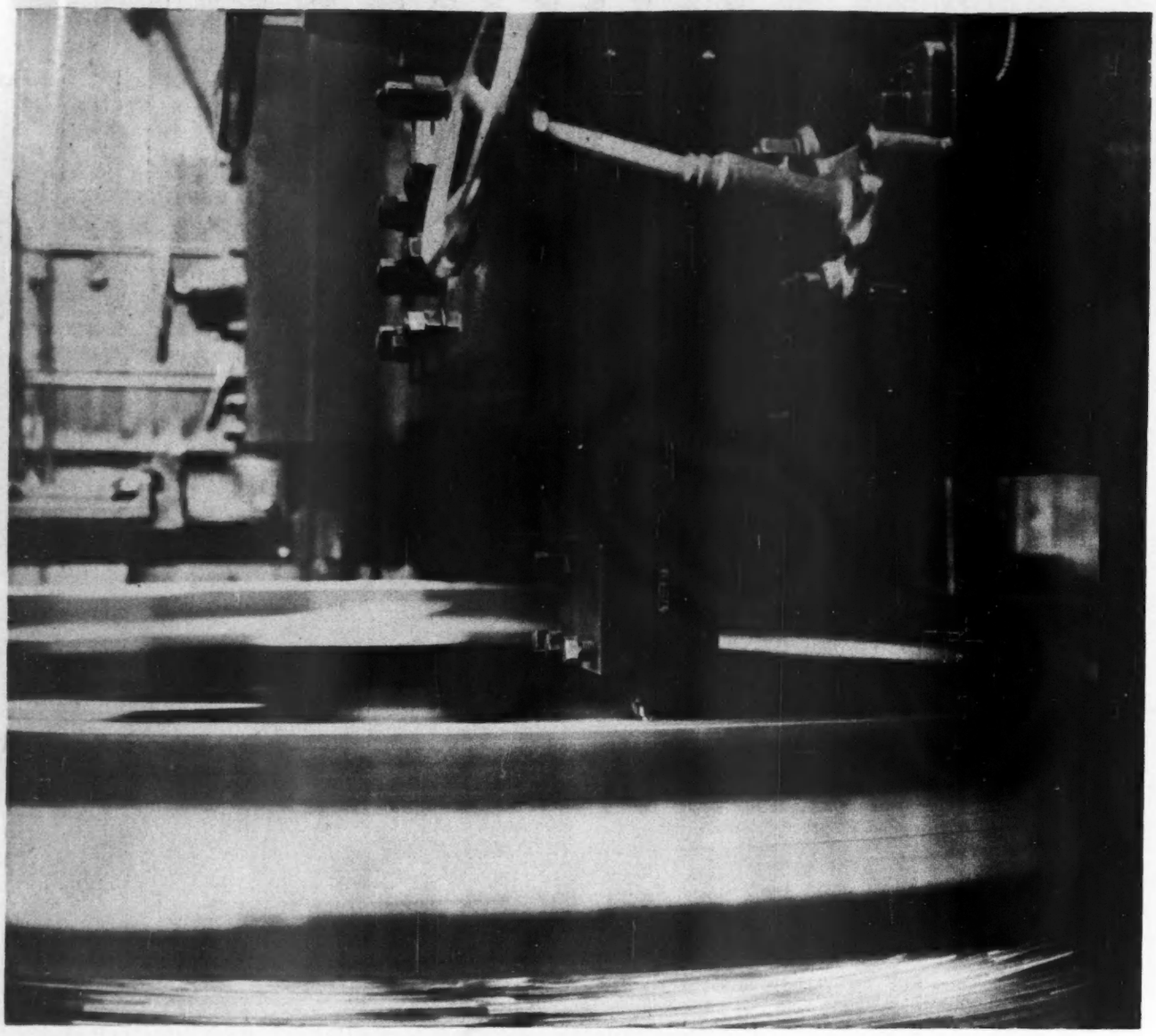
Make it Yourself With Silicone Rubbers

Sandstone Dictates Choice of Gravity Dam

Reducing the Noise From Diesel Engines

PRICE
2/-

Paint Spraying



turning out

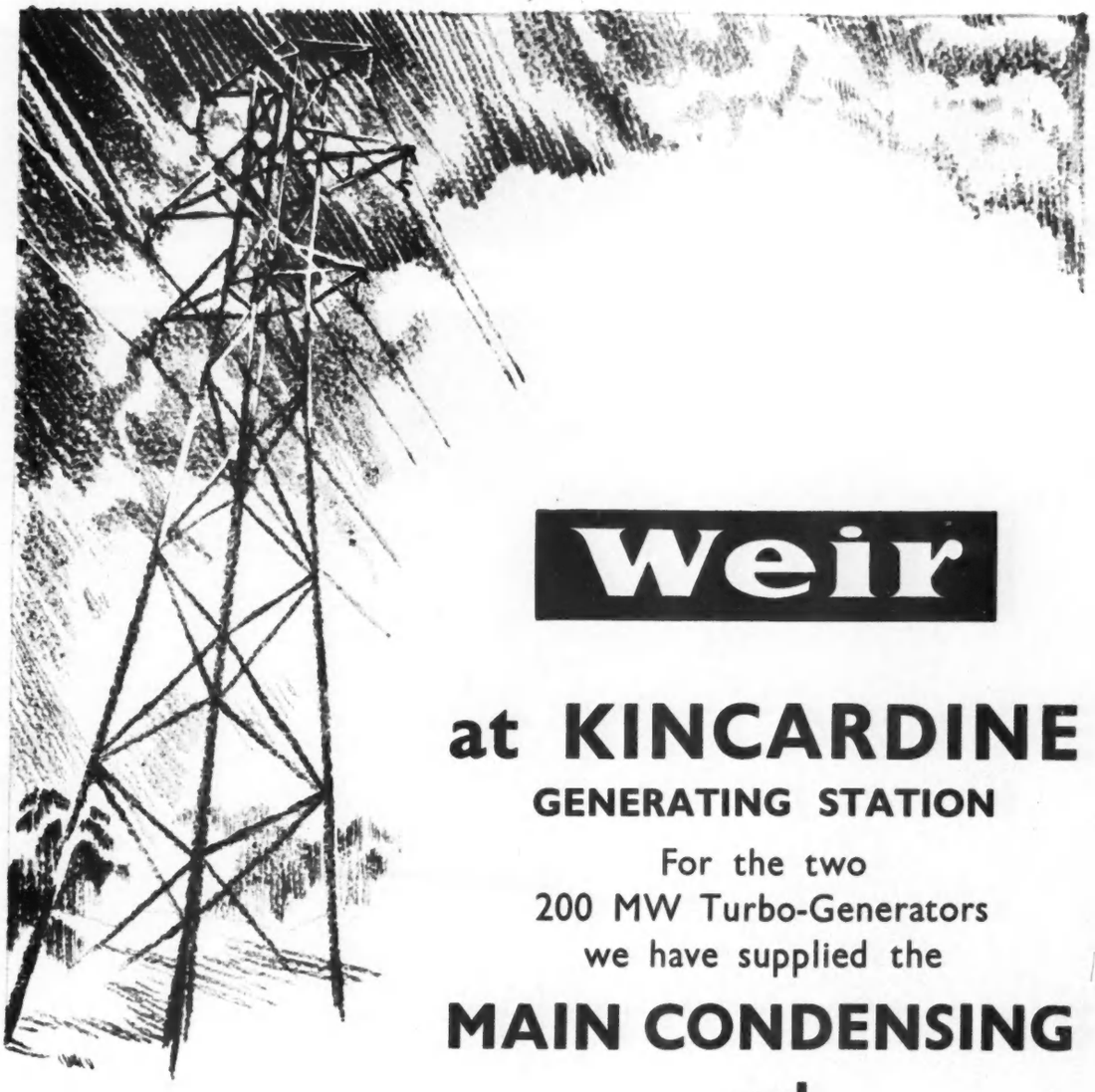
the big stuff is nothing new for Crofts. They've been doing it for years. Really big stuff, too. Spur and helical gears up to 185in. diameter, 37in. face width, 5in. CP—that's the way Crofts talk.
Here's a spur in Crofts fitting shop being turned into a powerful help to somebody, and it could be you. When it comes to big stuff (casting, machining and cutting), call Crofts—they've been doing it for years.

** Customer's blanks can be cut and gears manufactured to special order, but remember Crofts STOCK RANGE includes Spur and Mitre Gear Drives up to 70 h.p. and Bevel Gears up to 44 h.p. We also produce Internal Gears, Racks and Pinions, Worms and Wheels, Spiral Bevels and Spiral Mitres. And Crofts can handle Steel Castings up to 8 tons!*
Publication 159L tells the whole story—your copy's waiting.

For EX-STOCK service in BIRMINGHAM ring ASTon Cross 4471/2

Crofts

CROFTS (ENGINEERS) LIMITED
POWER TRANSMISSION ENGINEERS
THORNBURY BRADFORD 3 YORKSHIRE Telephone: 65251 (20 lines)
Telegrams: "Crofters Bradford Telex" Telex 51186
BRANCHES AT: Belfast, Birmingham, Bristol, Cardiff, Dublin, Glasgow, Ipswich, Leeds, Liverpool, London, Manchester, Newcastle, Northampton, Nottingham, Sheffield, Stoke-on-Trent
Subsidiary Companies in Canada, South Africa, U.S.A. World-wide Representation



Weir

at KINCARDINE

GENERATING STATION

For the two
200 MW Turbo-Generators
we have supplied the

MAIN CONDENSING and FEED HEATING PLANT

and a

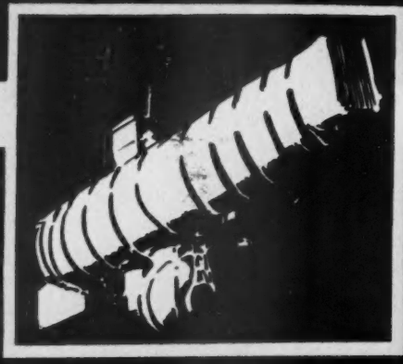
Dump Condensing Plant

to the order of
the South of Scotland Electricity Board
through the General Electric Co. Ltd.,
the main contractors.

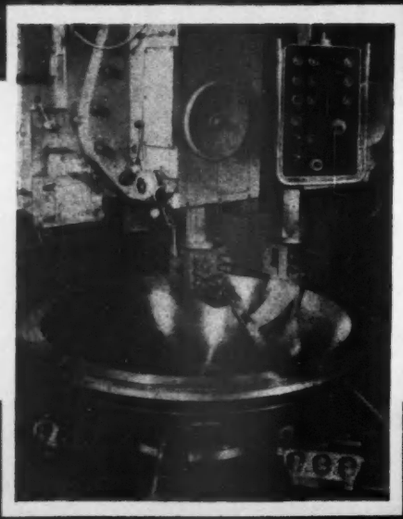
Weir

G. & J. WEIR LTD. • CATHCART • GLASGOW • S.4

GETTING TO THE BOTTOM OF THINGS



The Piccard bathyscaphe



A descent of more than seven miles below the ocean surface was made on the 23rd January 1960 by Jacques Piccard in a bathyscaphe invented by his father, Professor August Piccard. The descent was to the bottom of the Marianas Trench in the Pacific Ocean. The bathyscaphe which made this achievement possible was required to withstand a test force of 172,000 tons and a pressure of 1,200 atmospheres. Extreme accuracy was demanded in the machining of the mating faces of the separate parts of the bathyscaphe which were joined metal to metal without any form of seal. The tolerance was one micron—a thousandth part of a millimeter.

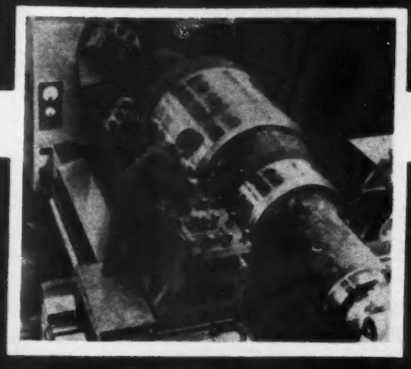
Machining operations were carried out by the newest type of FRORIEP Double Column Vertical lathe.

FRORIEP

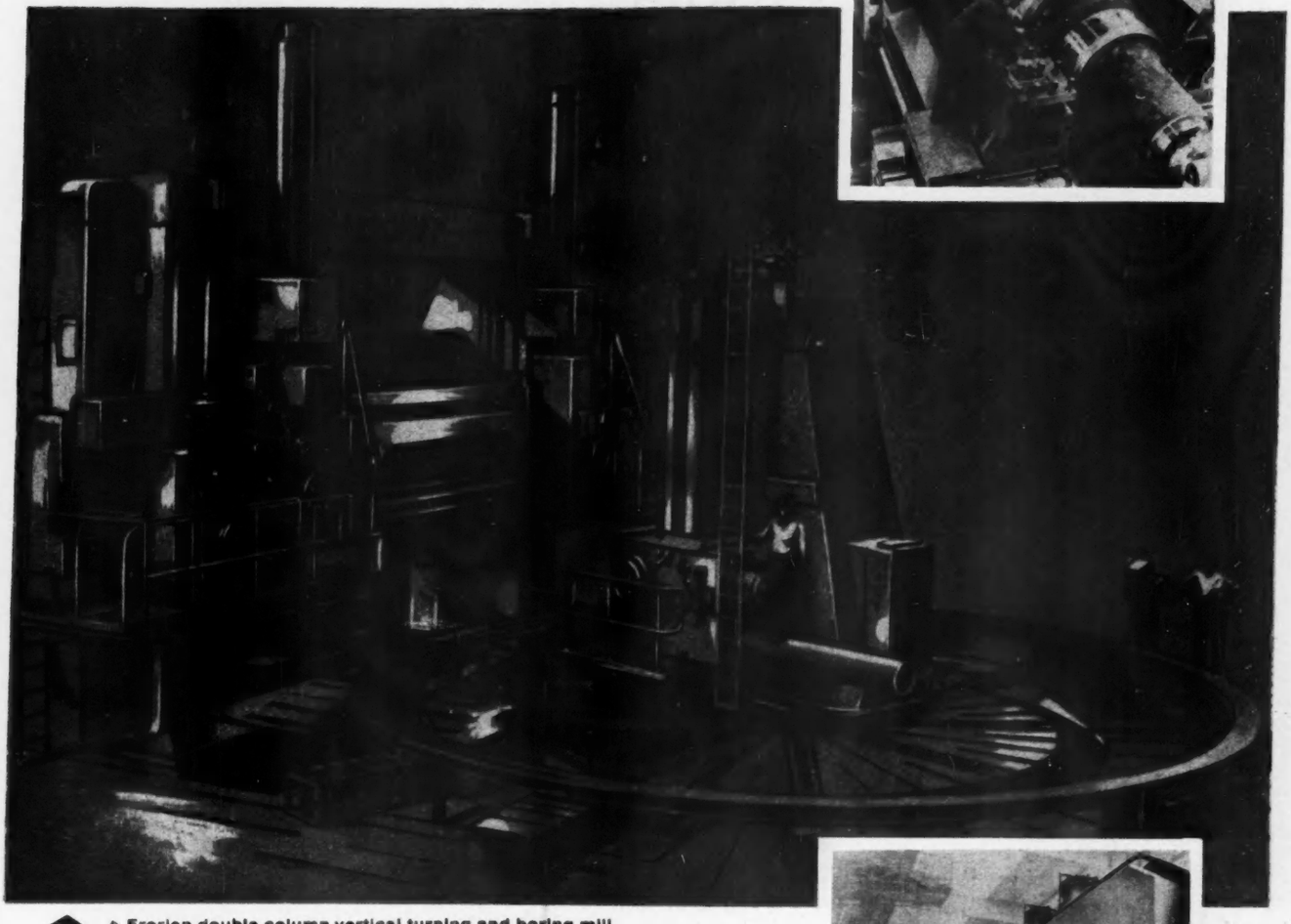
Charles Churchill & Company Limited Birmingham Branches at London Glasgow Newcastle Manchester

WITH THE HELP OF FRORIEP

HEAVY MACHINE TOOLS



A Froriep heavy lathe



A Froriep double column vertical turning and boring mill

Froriep are the leading Continental manufacturers of heavy machine tools. Their range of machines includes:—Vertical Turret Lathes, Double Column Vertical Turning and Boring Machines, Heavy Centre Lathes, Horizontal Boring and Milling Machines, Square Ingot Roughing Milling Machines, Test Bar Milling Machines, Plate Edge Planing Machines, Ship Plate Bending Machines, Hydraulic Tube Swaging Presses and many others. When you are next in the market for heavy equipment see what Froriep have to show.

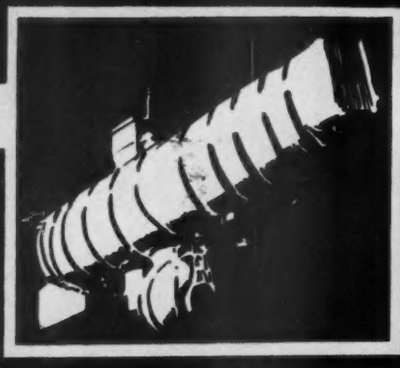
Froriep plate edge planing machine

FOR ALL FRORIEP MACHINES SEE

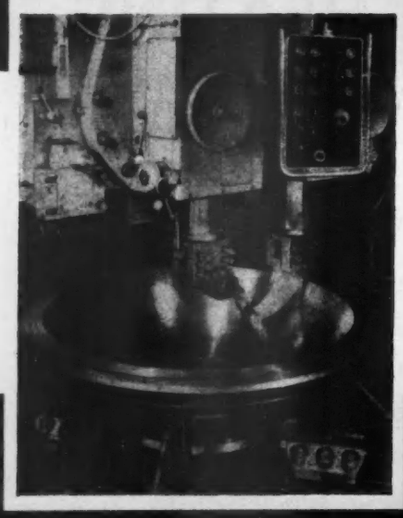
CHARLES CHURCHILL

Charles Churchill & Company Limited Coventry Rd South Yardley Birmingham 25 Tel: Acocks Green 2281 Grams: OPODELDOC BIRMINGHAM

GETTING TO THE BOTTOM OF THINGS



The Piccard bathyscaphe



A descent of more than seven miles below the ocean surface was made on the 23rd January 1960 by Jacques Piccard in a bathyscaphe invented by his father, Professor August Piccard. The descent was to the bottom of the Marianas Trench in the Pacific Ocean. The bathyscaphe which made this achievement possible was required to withstand a test force of 172,000 tons and a pressure of 1,200 atmospheres. Extreme accuracy was demanded in the machining of the mating faces of the separate parts of the bathyscaphe which were joined metal to metal without any form of seal. The tolerance was one micron—a thousandth part of a millimeter.

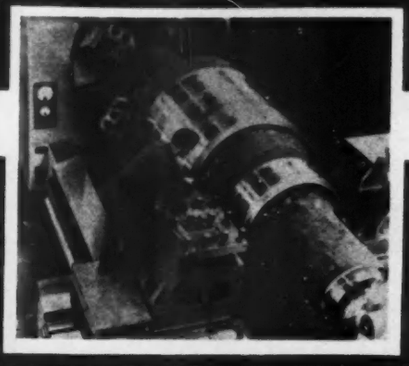
Machining operations were carried out by the newest type of FRORIEP Double Column Vertical lathe.

FRORIEP

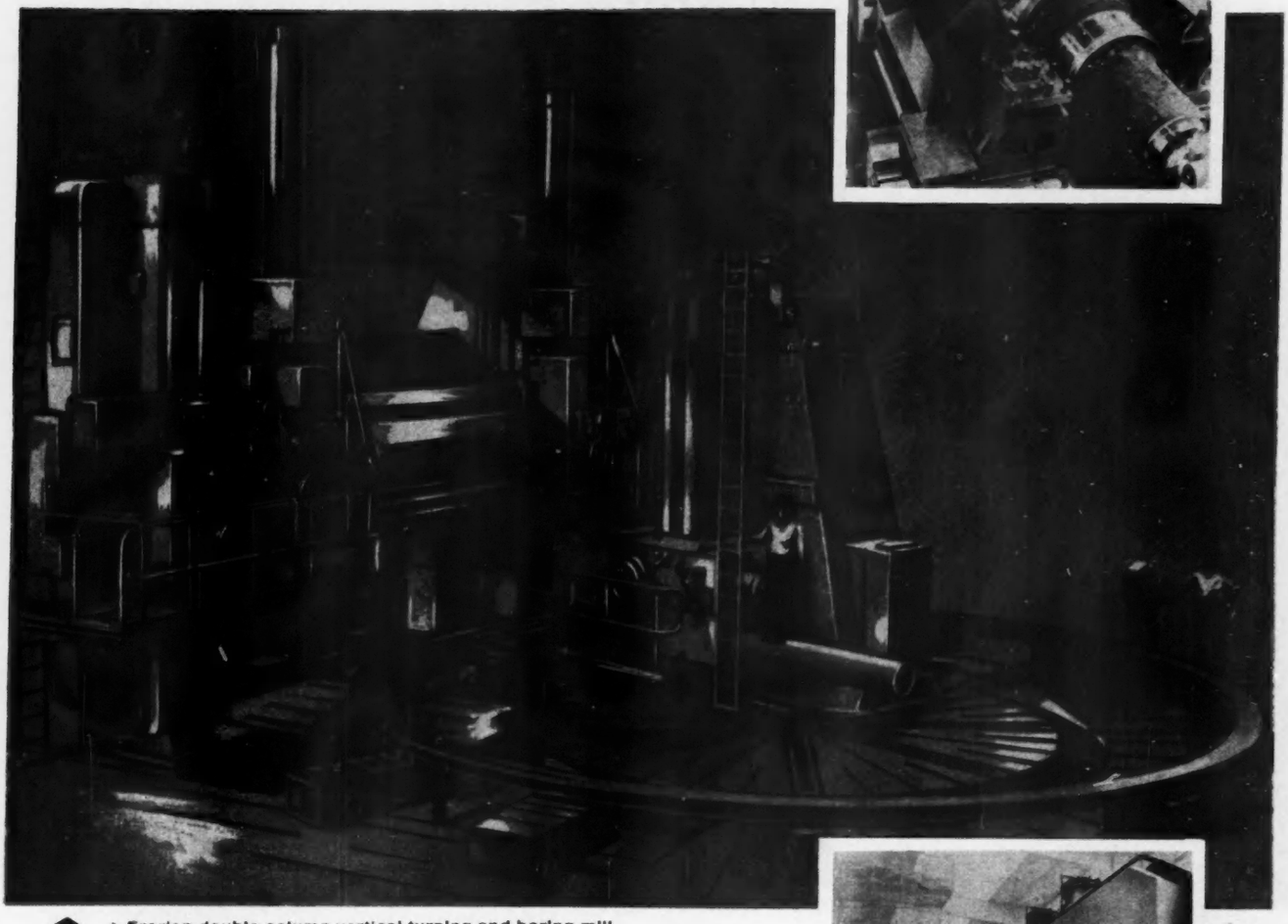
Charles Churchill & Company Limited Birmingham Branches at London Glasgow Newcastle Manchester

WITH THE HELP OF FRORIEP

HEAVY MACHINE TOOLS



A Froriep heavy lathe



A Froriep double column vertical turning and boring mill

Froriep are the leading Continental manufacturers of heavy machine tools. Their range of machines includes:—Vertical Turret Lathes, Double Column Vertical Turning and Boring Machines, Heavy Centre Lathes, Horizontal Boring and Milling Machines, Square Ingot Roughing Milling Machines, Test Bar Milling Machines, Plate Edge Planing Machines, Ship Plate Bending Machines, Hydraulic Tube Swaging Presses and many others. When you are next in the market for heavy equipment see what Froriep have to show.

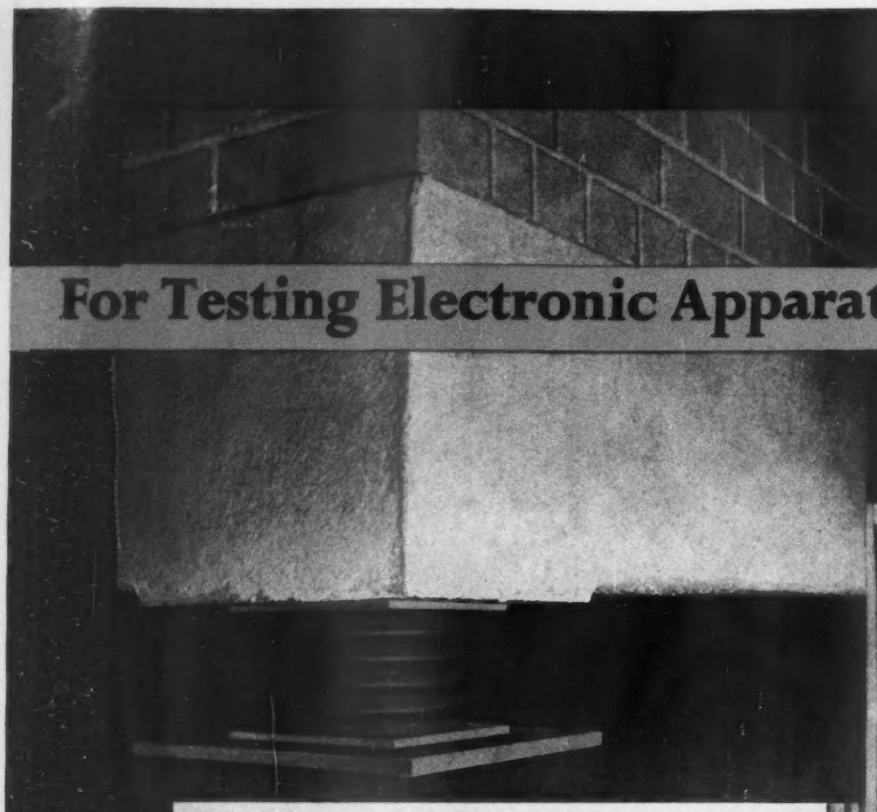
Froriep plate edge planing machine

FOR ALL FRORIEP MACHINES SEE

CHARLES CHURCHILL

Charles Churchill & Company Limited Coventry Rd South Yardley Birmingham 25 Tel: Acocks Green 2281 Grams: OPODELDOC BIRMINGHAM

For Testing Electronic Apparatus



Isolating a 40-ton sound-proof room from ground vibration

Dawe Instruments Ltd., wished to isolate from ground-borne vibration a 40-ton anechoic chamber used for the calibration of sound level meters.

The chamber was mounted on eight Metalastik sandwich type insulators giving a static deflection of 0.25". These are giving excellent insulation against ground-borne vibrations with disturbing frequencies of 1000 cycles per minute and upwards.

In most cases trouble from vibration, or noise due to vibration, is most easily overcome by isolating the disturbance at source. Among the many Metalastik anti-vibration mountings for industrial machinery, lifts and ventilating equipment is the famous "Cushyfoot". A brochure on the application of Cushyfoot mountings to a wide variety of machines is available on request.

Anechoic and Reverberation chambers at the Hemel Hempstead laboratories of the Acoustical Investigation and Research Organisation Ltd.,—independent consultants in Acoustics—are supported on large rubber-bonded-to-metal mountings supplied by Metalastik. Photograph shows interior of the Anechoic chamber.

An acoustic ceiling suspended on "Metacone" anti-vibration mountings which bring the natural frequency of the ceiling below the audible range and thus prevent resonant vibration due to air-borne noise. Photograph by courtesy of Werkspoor N.V., Amsterdam.

METALASTIK

METALASTIK LTD., LEICESTER

18 November 1960

Vol. 190 No. 4935

Founded in 1866

ENGINEERING

PUBLISHED EVERY FRIDAY

36 Bedford Street London WC2 England Telephone: Temple Bar 3663

Contents

670 Metals and Materials

Make It Yourself with Silicone Rubbers

Fight Condensation with Vermiculite Cement, Aluminium Busbars Take 10,000 Amps, Acceptance of Vitreous Enamelled Aluminium, Hot Pipe Insulation

675 New Plant and Equipment

Bulk Tanker, Jig Borer, Cooling Unit, Dust Collector, High Speed Angle Grinder, Fork Lift Truck

Public Works Exhibition:—
Drag Shovel, Mobile Washer, Dump Truck, Scale Feeder, Drilling Rig, Tractor Shovel

680 Construction

Sandstone Dictates Choice of Gravity Dam

689 Research and Development

Combustion Study at Supersonic Speeds

Computer Used to Study Human Eye, Automatic Gauge and Tension for Tinplate, Annular Combustion Chamber of Free Piston Gasifier, Air Intakes at Subsonic Speeds, Basic Research into Ceramic Fracture, Influence of Soil on Underground Cables, Control of Combustion Gases, Straightening Polished Sheet Metal, Level Indicator for Liquid Helium

697 Production

Automatic Hard Chromium Plating in Use

Packing Bags at High Speeds, Protective Coatings for Heavy Equipment, Hot Dimpling, Optical Depth Control, Clean Pipework for Nuclear Reactors

700 Operation and Maintenance

Launching Black Knight Without Fail

Cost of Heating Office Blocks by Heat Pump, Diesel Starting in a Cold Climate

702 Design

Plastic Dot Braille Cuts Book Thickness by Half, Flexible Seal Provides Easily Operated Door, Variable-Speed Reduction Unit Giving Constant Torque, Shop Blind Operates With the Sun, Toroidally-Wound Variable Transformer, Portable Filter for Insulating Oils, British Standard for Tubular Heat Exchangers, Automatic Oscillator Hydraulically Controlled, Push-In Ball Castor, Ship has V-Belt Drive

669 Impact

677 Human Element

685 Companies

695 Marketing

686 Product Profile

The GWB Powermaster Packaged Boiler

Special Articles

678 Helping Engineers Gain Independence

682 A New Approach to Strength of Materials
By Professor R. E. D. Bishop

683 Atomic Review

Compact Integration

696 Automobile Review

Reducing Noise from Diesel Engines

704 At Home

Work and Play on Wheels

672 Plain Words

By Capricorn

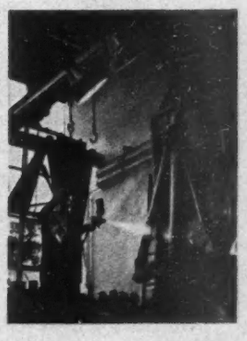
672 Letters to the Editor

A Bridgehead for Trade?
R. M. A. Braine
Television Definition
R. B. Bulman
Congestion and the Traffic Engineer
Professor W. Fisher Cassie
Selecting Future Foremen
John Davison
Spiral Conduit Ducting
J. A. E. Heard
University Reactor Licences
Professor J. M. Kay and Dr. C. G. James
Railway Expenditure
M. J. Keedwell
Engineers on British Railways
John Ratter

674 Events in Advance

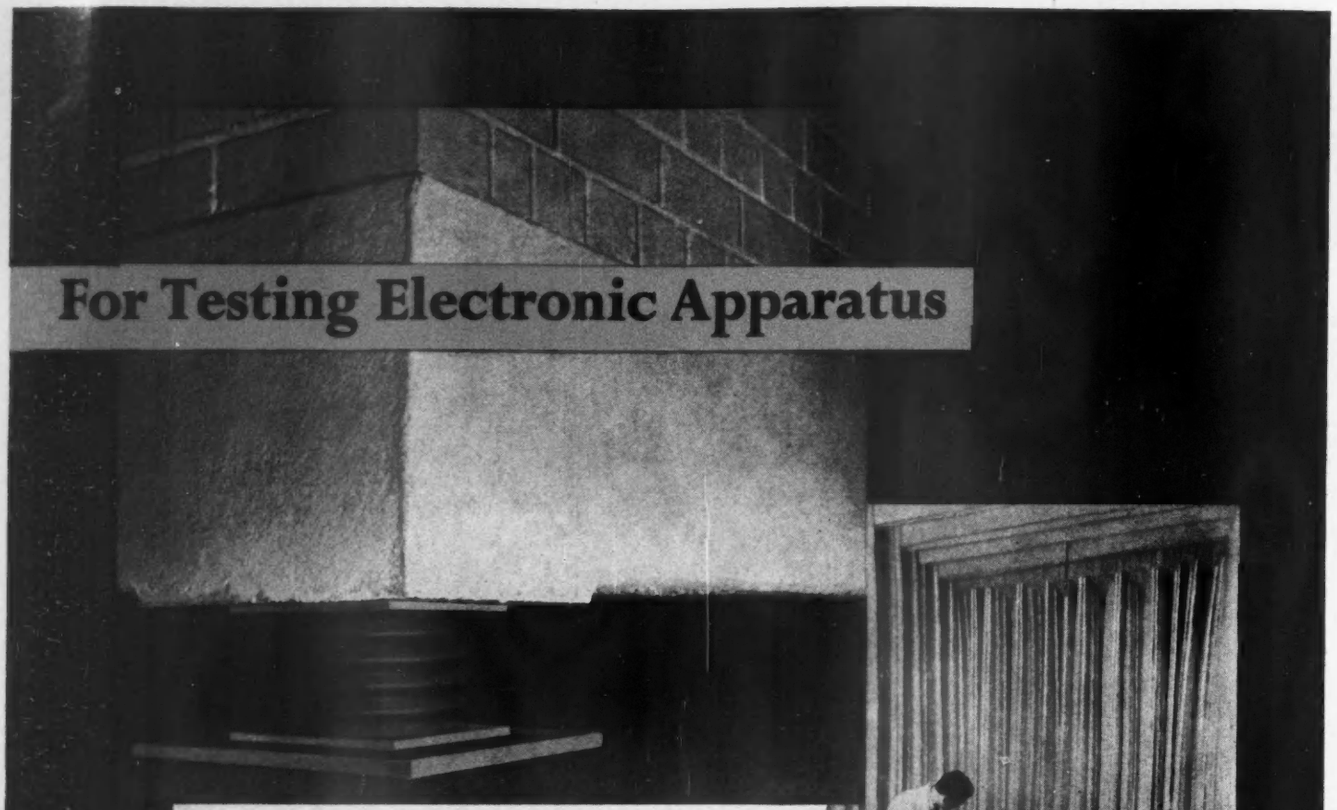
692 Publications

On the Shelf
By Frank H. Smith
Teaching Through Television
The Aeroplane: An Historical Survey of Its Origins and Development
Ballistics and Guided Missiles
Introduction à l'Étude de la Rhéologie
Deformation, Strain and Flow: An Elementary Introduction to Rheology
Statics of Soil Media
New Books and Trade Publications



Cover Picture

Paint spraying the retracting strut of a Vulcan undercarriage. (*Nurnberg photograph for* ENGINEERING)



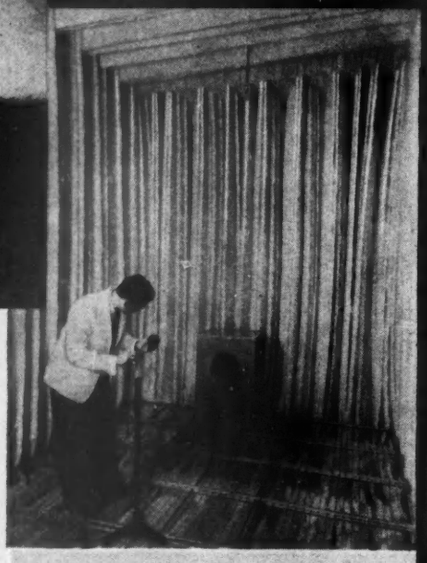
For Testing Electronic Apparatus

Isolating a 40-ton sound-proof room from ground vibration

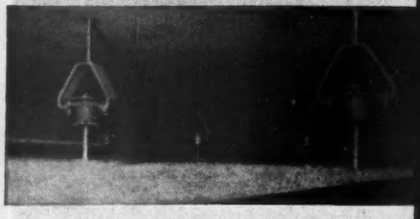
Dawe Instruments Ltd., wished to isolate from ground-borne vibration a 40-ton anechoic chamber used for the calibration of sound level meters.

The chamber was mounted on eight Metalastik sandwich type insulators giving a static deflection of 0.25". These are giving excellent insulation against ground-borne vibrations with disturbing frequencies of 1000 cycles per minute and upwards.

In most cases trouble from vibration, or noise due to vibration, is most easily overcome by isolating the disturbance at source. Among the many Metalastik anti-vibration mountings for industrial machinery, lifts and ventilating equipment is the famous "Cushyfoot". A brochure on the application of Cushyfoot mountings to a wide variety of machines is available on request.



Anechoic and Reverberation chambers at the Hemel Hempstead laboratories of the Acoustical Investigation and Research Organisation Ltd.,—independent consultants in Acoustics—are supported on large rubber-bonded-to-metal mountings supplied by Metalastik. Photograph shows interior of the Anechoic chamber.



An acoustic ceiling suspended on "Metacone" anti-vibration mountings which bring the natural frequency of the ceiling below the audible range and thus prevent resonant vibration due to airborne noise. Photograph by courtesy of Werkspoor N.V., Amsterdam.

METALASTIK

METALASTIK LTD., LEICESTER

18 November 1960

Vol. 190 No. 4935

Founded in 1866

ENGINEERING

PUBLISHED EVERY FRIDAY

36 Bedford Street London WC2 England Telephone: Temple Bar 3466

Contents

670 Metals and Materials

Make It Yourself with Silicone Rubbers

Fight Condensation with Vermiculite Cement, Aluminium Busbars Take 10,000 Amps, Acceptance of Vitreous Enamelled Aluminium, Hot Pipe Insulation

675 New Plant and Equipment

Bulk Tanker, Jig Borer, Cooling Unit, Dust Collector, High Speed Angle Grinder, Fork Lift Truck

Public Works Exhibition:—
Drag Shovel, Mobile Washer, Dump Truck, Scale Feeder, Drilling Rig, Tractor Shovel

680 Construction

Sandstone Dictates Choice of Gravity Dam

689 Research and Development

Combustion Study at Supersonic Speeds

Computer Used to Study Human Eye, Automatic Gauge and Tension for Tinplate, Annular Combustion Chamber of Free Piston Gasifier, Air Intakes at Subsonic Speeds, Basic Research into Ceramic Fracture, Influence of Soil on Underground Cables, Control of Combustion Gases, Straightening Polished Sheet Metal, Level Indicator for Liquid Helium

697 Production

Automatic Hard Chromium Plating in Use

Packing Bags at High Speeds, Protective Coatings for Heavy Equipment, Hot Dimpling, Optical Depth Control, Clean Pipework for Nuclear Reactors

700 Operation and Maintenance

Launching Black Knight Without Fail

Cost of Heating Office Blocks by Heat Pump, Diesel Starting in a Cold Climate

702 Design

Plastic Dot Braille Cuts Book Thickness by Half, Flexible Seal Provides Easily Operated Door, Variable-Speed Reduction Unit Giving Constant Torque, Shop Blind Operates With the Sun, Toroidally-Wound Variable Transformer, Portable Filter for Insulating Oils, British Standard for Tubular Heat Exchangers, Automatic Oscillator Hydraulically Controlled, Push-In Ball Castor, Ship has V-Belt Drive

669 Impact

677 Human Element

685 Companies

695 Marketing

686 Product Profile

The GWB Powermaster Packaged Boiler

Special Articles

678 Helping Engineers Gain Independence

682 A New Approach to Strength of Materials
By Professor R. E. D. Bishop

683 Atomic Review

Compact Integration

696 Automobile Review

Reducing Noise from Diesel Engines

704 At Home

Work and Play on Wheels

672 Plain Words

By Capricorn

672 Letters to the Editor

A Bridgehead for Trade?
R. M. A. Braine
Television Definition
R. B. Bulman
Congestion and the Traffic Engineer
Professor W. Fisher Cassie
Selecting Future Foremen
John Burton
Spiral Conant Dueting
J. M. E. Heard
University Research Fiefdoms
Professor J. M. Kay and Dr. C. C. James
Railway Expenditure
M. J. Kaufhell
Engineers on British Railways
John Rutter

674 Events in Advance

692 Publications

On the Shelf
By Flint H. Sutro
Teaching Through Television
The Aeroplane: An Historical Survey of Its Origins and Development
Ballistics and Guided Missiles
Introduction à l'Étude de la Rhéologie
Deformation, Strain and Flow: An Elementary Introduction to Rheology
Statics of Soil Media
New Books and Trade Publications

Cover Picture

Subscription Rates: Editorial page 704

Engineering Appointments Section, Page page 693

section.

Advertisers in 'Engineering' this week

	PAGE
AFSA, Ltd.	71
Acheson Colloids, Ltd.	65
Acratork Eng'g. Co., Ltd.	35
Adamson, J., & Co., Ltd.	44
Allday, W., & Co., Ltd.	5
Allen, A. H., & Co., (Engineers) Ltd.	66
Amal, Ltd.	50
Armstrong Patents Co., Ltd.	23
Armstrong-Whitworth (Metal Industries) Ltd.	51
Associated Electrical Industries, Ltd.	
Heavy Plant Division.	34
Transformer Division.	38
Atlas Copco A.B. (Sweden)	41
Austin, R., & Sons (London) Ltd.	71
Automotive Products Co., Ltd. *Wrapper*	VII
Baker, P. W., & Sons (Sales) Ltd.	36
Barry Henry & Cook, Ltd.	70
Begg, Cousland & Co., Ltd.	30
Bennett, (Hyde) Ltd.	33
Berry, H., & Co., Ltd.	56
Biundell & Crompton, Ltd.	10
Booth, Joseph, & Bros.	61
Borg & Beck Co., Ltd. *Wrapper*	VII
British Belting & Asbestos Ltd.	9
British Ermeto Corpn., Ltd.	11
British Oxygen Co., Ltd.	45
British Paints, Ltd.	77
British Steam Specialties Ltd.	55
British Steelfounders Association	20
Broom & Wade, Ltd. 18 &	19
Brown, David, Corpn. (Sales) Ltd.	42
Carter, B. & F., & Co., Ltd.	35
Centrax, Ltd.	44
Chesterfield Tube Co., Ltd.	46
Churchill, Charles, & Co., Ltd. *Wrapper*	IV & V
Clyde Crane & Booth, Ltd.	61
Clyde Crane & Eng'g. Co.	61
Cohen, G., Sons & Co., Ltd.	12
Consolidated Pneumatic Tool Co., Ltd.	26
Contactor Switchgear, Ltd.	6
Conveyor & Elevator Co. (1936) Ltd.	10
Crane Packing, Ltd.	69
Crofts (Engineers) Ltd. *Wrapper*	II
Dacron (Plan-o-Matic) Ltd.	11
Dallow Lambert, Ltd.	16
Demag, AG.	37
Denison, S., & Son, Ltd.	5
Eagle Pencil Co.	61
Elitron (London) Ltd.	76
"Engineering" Calendar	78
"Engineering" Reprints	33 & 70
Engelhard Industries, Ltd.	17
English Electric Co., Ltd.	57
Expanded Metal Co., Ltd.	70
Falk, Stadelmann & Co., Ltd.	49
Firth Brown Tools, Ltd.	22
Firth, Thos., & John Brown, Ltd.	67
Flexible Ducting, Ltd.	77
Godfrey, Sir G., & Partners (Industrial) Ltd.	75
Gordon, James, & Co., Ltd.	66
Grafton Cranes, Ltd.	30
Green, R., Ltd.	29
Greenwood & Batley, Ltd.	79
Guest Keen & Nettlefolds (Midlands) Ltd.	32
Gwynnes Pumps, Ltd.	13
Hall, J. & E., Ltd.	74
Hartleys (Stoke-on-Trent) Ltd.	4
Heap, J., & Co., Ltd.	55
Heenan & Froude, Ltd.	33
Herbert, A., Ltd.	65
Hockley Foundry Co., Ltd.	70
Honeywell Controls, Ltd.	54
Industrial Pumps, Ltd.	8
International Computers & Tabulators, Ltd.	48
Jones & Lloyd, Ltd.	44
Joy-Sullivan, Ltd.	64
Kinnings, Arnold, & Sons, Ltd.	2
Lee, A., & Sons, Ltd.	58
Low, A., & Sons, Ltd.	15
Lysaght-De Vilbiss Division of J. Lysaght's Ltd. *Wrapper*	VIII
McNeil, C., Ltd.	29
Marinite, Ltd.	73
Marston Excelsior, Ltd.	6
Mather & Platt, Ltd.	4
Mavor & Coulson, Ltd.	62
Metalastik, Ltd. *Wrapper*	VI
Micanite & Insulators Co., Ltd.	50
Millspaugh, Ltd.	80
Mirrlees, Bickerton & Day, Ltd.	27
Mond Nickel Co., Ltd.	42
Morgan Crucible Co., Ltd.	52
Morgan-Mintex, Ltd.	9
National Coal Board.	24 & 25
Newbury Diesel Co., Ltd.	76
Nitralloy, Ltd.	11
Northey Rotary Compressors, Ltd.	10
Odoni Epuipment, Ltd.	8
Palnut Co., Ltd.	50
Parks Forge, Ltd.	44
Parsons, C. A., & Co., Ltd.	59
Pegler & Louden, Ltd.	71
Pegiers, Ltd.	40
Plant Engineers, Ltd.	21
Power Auxiliaries, Ltd.	76
Power Plant Co., Ltd.	55
Reavell & Co., Ltd.	46
Regent Oil Co., Ltd.	39
Reyrolle, A., & Co., Ltd.	60
Richards, G., & Co., Ltd.	7
Robson, G., & Co., (Conveyors) Ltd.	76
Saunders-Roe, Ltd. (Electronics Division)	31
Scriven Machine Tools, Ltd.	44
Serck, H. O., Ltd.	55
Service Electric Co., Ltd.	46
Smiths Industrial Instruments, Ltd.	66
Sound Control, Ltd.	72
South Durham Steel & Iron Co., Ltd.	63
Sparklets, Ltd.	45
Spiro-Gills, Ltd.	53
Steele & Cowlishaw, Ltd.	71
Sulzer Bros. (London) Ltd.	14
Taylor & Hubbard, Ltd.	35
Taylor Industrial Clutches	76
Tonks, J., & Co., Ltd.	70
Town, F. & Sons, Ltd.	47
Turbine Gears, Ltd.	68
Vokes Genspring, Ltd.	28
Waller, G., & Son, Ltd.	30
Weir, G. & J., Ltd. *Wrapper*	III
Wellman Bibby Co., Ltd.	5
Wellman Smith Owen Eng'g. Corpn., Ltd.	78
Whittaker, Hall & Co. (1929) Ltd.	8
Worcester Valve Co., Ltd.	10

'Engineering' Appointments Section inside Editorial Section

Admiralty, Navy Works Department	2 & 3
Associated Electrical Industries, Ltd.	4
Atomic Power Constructions, Ltd.	2 & 3
Australia, Commonwea th of	2
Bata Development, Ltd.	2
Hawker Siddeley Brush Turbines, Ltd.	2
Management Selection Ltd.	3
New South Wales Government	4
Tube Investments, Ltd.	1
United Kingdom Atomic Energy Authority	4
Worcester County Council	2

Classified: Trade & Technical

Admiralty, Navy Works Department	3
Bell, H. (Machine Tools) Ltd.	3
Central Electricity Board of the Federation of Malaya	3
Edwards, F. J., Ltd.	3
Mayer, Newman & Co., Ltd.	4
Norris Bros., Ltd.	4
Office of India Supply Mission, The	3
Plint & Ptns., Ltd.	4
Research Engineers, Ltd.	4
Woolwich Polytechnic	3

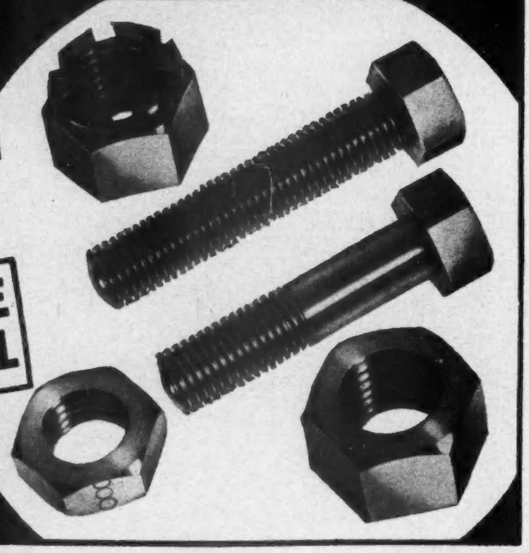
ARNOLD KINNINGS of Southport

BRIGHT STEEL BOLTS NUTS & SETSCREWS

Sizes: Nuts 4BA to 1½" dia. nominal
Bolts & Setscrews 5/16" to 1" dia. nominal

ANY STANDARD TYPE & ALMOST ANY SPECIAL

Material: Nuts 28 & 40 ton steel (Code A & P)
Bolts & Setscrews 28 ton steel (Code A)



ARNOLD KINNINGS & SONS LTD.
NORWOOD ROAD SOUTHPORT LANCS.
TELEPHONE: SOUTHPORT 3182 (3 lines)

Trade and Technical

EDUCATIONAL

POSTAL COURSES

A.M.I.MECH.E., B.Sc., CITY AND GUILDS, etc. Guaranteed POSTAL COURSES for all Exams. and technical divisions from Elementary to Degree standard. Approximately 95 per cent. successes. 154-page prospectus free on request:—
B.I.E.T (DEPT. 28),
29, WRIGHT'S LANE,
LONDON, W.8. G 896

WOOLWICH POLYTECHNIC
DEPARTMENT OF COMMERCE AND MANAGEMENT STUDIES
SHORT FULL-TIME MANAGEMENT COURSES

WORK STUDY
Four weeks full-time concentrated practical course for Executives:—
1. COMMENCES 21st NOVEMBER, 1960.
2. COMMENCES 10th APRIL, 1961.

PRODUCTION PLANNING A&D CONTROL
Three weeks full-time course for Production Planning and Control Executives:—
1. COMMENCES 6th MARCH, 1961.
2. COMMENCES 12th JUNE, 1961.

Write NOW for reservation form and further details to:— REF. DS/CLW, WOOLWICH POLYTECHNIC, LONDON, S.E.18. D 417

TENDERS

N.A.T.O. COMMON INFRASTRUCTURE
SLICE VIII
NAVAL BASE INSTALLATIONS

FINAL NOTICE is hereby given that International Competitive Bids will be invited on or about 28th DECEMBER, 1960, for the supply and installation of JETTY OIL FLOW-BOOM EQUIPMENT at a P.O.L. STORAGE DEPOT to be built in the CAMPBELTOWN AREA OF SCOTLAND.

The approximate cost of the contract will be £32,000 and will comprise:—
1 No. Complete Oil Flow-Boom Equipment for 7 No. 10 inch hose connections and including 1 No. light derrick.

The work will be carried out as one contract which will be undertaken as a sub-contract within the framework of the Main Contract for the construction of the depot. Bids for the Main Contract will be invited shortly.

It should be noted that the importation of labour from sources outside of the United Kingdom may be subject to restriction and that permission could in any case only be given on an undertaking that the Contractor would pay rates of wages and observe hours and conditions of labour not less favourable than those established for U.K. labour for the trade or industry in the same area.

The closing date for the receipt of bids will be 28th February, 1961.

Firms wishing to bid must formally notify their desire by application to the address below by 28th November, 1960.

Within one week after the closing date for the receipt of applications to bid, firms wishing to be invited must forward the following information:—
(i) Statement of financial resources and evidence of financial stability.
(ii) Details of recent major contracts completed for work of a comparable nature including an indication of the value of each.

Enquiries regarding bidding should be addressed to:—
DIRECTOR GENERAL, NAVY WORKS,
ADMIRALTY,
CHAMBERLAIN WAY,
PINNER,
MIDDLESEX,
ENGLAND,
quoting Reference NWD/Infra/19 (Sub-Contract Flow-Boom Equipment). D 397

THE OFFICE OF THE DIRECTOR GENERAL, INDIA STORE DEPARTMENT, GOVERNMENT BUILDING, BROMYARD AVENUE, ACTON, W.3, invite TENDERS for the following:—

AUTOMATIC HORIZONTAL HEAD TURNING AND MOUTH REAMING MACHINE.

Specifications, etc., relative to the above specification, can be obtained from the COORDINATION BRANCH, INDIA STORE DEPARTMENT, BROMYARD AVENUE, ACTON, LONDON, W.3, at a cost of 10 shillings per tender, and is not refundable.

Tenders are to be returned to the INDIA STORE DEPARTMENT, BROMYARD AVENUE, ACTON, W.3, so as to reach them by 2 p.m. on THURSDAY, the 22nd DECEMBER, 1960.

Specimen copy of the above enquiry can be seen at ENGINEERING BRANCH, INDIA STORE DEPARTMENT, under the following reference: 2046/60/ENG.3/SGH. D 425

CENTRAL ELECTRICITY BOARD
OF THE
FEDERATION OF MALAYA
JOHORE BAHRU POWER STATION
CONTRACT EE 1737/2

TWO 150,000 LB. PER HOUR
BOILERS AND AUXILIARY PLANT

TENDERS are invited for the supply and installation of steam raising plant and associated auxiliaries for the FEDERATION OF MALAYA CENTRAL ELECTRICITY BOARD'S new power station at JOHORE BAHRU.

Tenders are invited only from firms who are prepared to submit complete tenders.

A short précis of the extent of the work and general conditions pertaining may be obtained on application to the CROWN AGENTS FOR OVERSEA GOVERNMENTS AND ADMINISTRATIONS, 4, MILLBANK, WESTMINSTER, LONDON, S.W.1. Applications should quote Ref. CONTRACT EE.1737/2.

Tender documents, which will be available from 14th NOVEMBER, 1960, and returnable by 1 p.m. on 27th JANUARY, 1961, may be obtained from the Crown Agents on receipt of a payment by cheque for £15 to be made in favour of the Crown Agents for Oversea Governments and Administrations. This payment will not be refunded.

The Central Electricity Board do not bind themselves to accept the lowest or any tender, nor will they be responsible for any costs incurred by tenderers in preparing their tender. D 399

N.A.T.O. COMMON INFRASTRUCTURE
SLICE VIII
NAVAL BASE INSTALLATIONS

FINAL NOTICE is hereby given that International Competitive Bids will be invited on or about 28th DECEMBER, 1960, for the supply and installation of PUMPING EQUIPMENT at a P.O.L. STORAGE DEPOT to be built in the CAMPBELTOWN AREA OF SCOTLAND.

The approximate cost of the contract will be £32,000 and will include:—
(a) For duty on furnace fuel oil:—
3 No. Steam Turbine Driven Centrifugal Pumps about 1100 cub. metres per hour capacity each.
1 No. Steam Driven Reciprocating Pump about 80 cub. metres per hour capacity.
(b) For duty on white oils:—
3 No. Electric Motor Driven Centrifugal Pumps about 50 cub. metres per hour capacity each.
3 No. Electric Motor Driven Centrifugal Pumps about 22 cub. metres per hour capacity each.
(c) For duty on ballast:—
1 No. Electric Motor Driven Screw Displacement Pump about 50 cub. metres per hour capacity.
(d) For duty on water:—
1 No. Electric Motor Driven Centrifugal Pump about 41 cub. metres per hour capacity.
1 No. Diesel Engine Driven Centrifugal Pump about 41 cub. metres per hour capacity.

The work will be carried out as one contract which will be undertaken as a sub-contract within the framework of the Main Contract for the construction of the depot. Bids for the Main Contract will be invited shortly.

It should be noted that the importation of labour from sources outside of the United Kingdom may be subject to restriction and that permission could in any case only be given on an undertaking that the Contractor would pay rates of wages and observe hours and conditions of labour not less favourable than those established for U.K. labour for the trade or industry in the same area.

The closing date for the receipt of bids will be 28th February, 1961.

Firms wishing to bid must formally notify their desire by application to the address below by 28th November, 1960.

Within one week after the closing date for the receipt of applications to bid, firms wishing to be invited must forward the following information:—
(i) Statement of financial resources and evidence of financial stability.
(ii) Details of recent major contracts completed for work of a comparable nature including an indication of the value of each.

Enquiries regarding bidding should be addressed to:—
DIRECTOR GENERAL, NAVY WORKS
ADMIRALTY,
CHAMBERLAIN WAY,
PINNER,
MIDDLESEX,
ENGLAND,
quoting Reference NWD/Infra/19 (Sub-Contract 6 Pumps) D 396

THE OFFICE OF THE INDIA SUPPLY MISSION,
2536, MASSACHUSETTS AVENUE N.W.,
WASHINGTON 8, D.C.,
UNITED STATES OF AMERICA

invites TENDERS for the supply of the equipment as listed below, required for the manufacture of STREPTOMYCIN BY HINDUST ANANTIBIOTICS LIMITED, INDIA:—

Indent No.	*Tender Enq. No.*	*Brief description of equipment required*	*Closing Date*	*Price for Tender*
PUR/ISM/STR/120	SE-281	Argon Arc Torch, Spot Welder (Portable), D.C. Welding Sets	Jan. 10 '61	$0.50 = 3s. 7d.
PUR/ISM/STR/121	SE-282	10 Ton Pulley Block	Jan. 10 '61	$0.50 = 3s. 7d.
PUR/ISM/STR/122	SE-283	Fittings for S.S. Tubing	Jan. 12 '61	$1.00 = 7s. 2d.
PUR/ISM/STR/123	SE-284	Pyrex Pipe, Fittings and Accessories	Jan. 17 '61	$1.00 = 7s. 2d.
PUR/ISM/STR/124	SE-285	PVC Pipe Fittings and Accessories	Jan. 17 '61	$1.00 = 7s. 2d.

Specifications, etc., relative to the above, can be obtained from the CO-ORDINATION BRANCH, INDIA STORE DEPARTMENT, BROMYARD AVENUE, ACTON, LONDON, W.3. The cost of tender sets are as indicated above and are not refundable.

Tenders are to be returned direct to INDIA SUPPLY MISSION, 2536, MASSACHUSETTS AVENUE N.W., WASHINGTON 8, D.C., UNITED STATES OF AMERICA, AND NOT TO THIS OFFICE, and are to reach them on the dates specified above against each enquiry number.

Specimen copies of the above enquiries can be seen at
ENGINEERING BRANCH,
INDIA STORE DEPARTMENT,
GOVERNMENT BUILDINGS,
BROMYARD AVENUE,
ACTON, LONDON, W.3,
under the above tender reference numbers. D 416

METROPOLITAN WATER, SEWERAGE AND DRAINAGE BOARD
NEW SOUTH WALES
AVON-SOUTH COAST WATER SUPPLY
CONTRACT NO. 3462-W

TENDERS are invited for the manufacture, supply, testing, delivery and initial maintenance of two alternatively three or four automatic needle type inlet control valves 30 in. nominal bore with associated electric D.C. motors and control gear; also two alternatively four 30 in. diameter manually operated stop valves.

Tender documents, including the specification and drawings, can be obtained on application to the Agent-General for New South Wales, 56 Strand, London, W.C.2.

Tenders must be submitted to the METROPOLITAN WATER, SEWERAGE AND DRAINAGE BOARD, 341, PITT STREET, SYDNEY, NEW SOUTH WALES, AUSTRALIA, by 2 P.M. on TUESDAY, 13th DECEMBER, 1960. D 430

PATENTS

THE PROPRIETORS OF BRITISH PATENT NO. 696620, for "IMPROVEMENTS IN OR RELATING TO HUBS COMPRISING BALL, ROLLER OR LIKE BEARINGS," are desirous of entering into negotiations for the sale of the Patent, or for the grant of a Licence thereunder.—Communications should be addressed to PAGE, WHITE & FARRER, 27, CHANCERY LANE, LONDON, W.C.2. D 415

FOR SALE OR HIRE

MASSEY 10 CWT. PNEUMATIC HAMMER for sale. Overhanging type with slides. Anvil and tup set as an angle. Arranged motor drive 400/3/50. Automatic or single blow. Complete with anvil. Centre of tup to back 23 in. Size of bar worked 5½ in. to 10 in. square. Weight 12½ tons.—F. J. EDWARDS LIMITED, 359, EUSTON ROAD, LONDON, N.W.1, or 41, WATER STREET, BIRMINGHAM 3. D 388

CINCINNATI-NO. 5H.P. MILLER. Table 83 in. by 21 in. Long. traverse 50 in. 20 h.p. motor 400/3/50.

H. BELL (MACHINE TOOLS) LTD.
WALTER STREET, LEEDS 4
Tel. 63-7398 G 884

LATTICE STEEL ERECTION MASTS (light and heavy), 20 ft. to 150 ft. high, for immediate hire.
BELLMAN'S
38 CORNWALL GARDENS
LONDON, S.W.7
Western 3038 G 899

SERVICE EDWARDS VALUE!

YEWCO POWER OPERATED GEARED OPEN ENDED GUILLOTINE SHEARING MACHINE. Motorised for 400-440/3/50 supply. Capacity 8 ft. by 10 s.w.g. With automatic sheet hold-down and front, back and side gauges. Weight approx. 68 cwt.

RHODES POWER OPERATED OPEN ENDED GUILLOTINE. Undercrank type. Motorised for 415/3/50 supply. Capacity 4 ft. by 14 s.w.g. With sheet hold-down and adjustable front, back and side gauges. Complete with three spare pairs of blades. Weight approx. 22 cwt.

RUSHWORTH POWER OPERATED DOUBLE GEARED OPEN ENDED GUILLOTINE SHEARING MACHINE. Motorised for 230/1/50 supply. Capacity 4 ft. by ½ in. With automatic sheet hold-down and adjustable front, back and side gauges. Weight approx. 50 cwt.

NEW MODEL BU100 UNIVERSAL DOUBLE ENDED PUNCHING, SHEARING, SECTION CROPPING AND NOTCHING MACHINE. All-steel construction. Motorised for 400/3/50 supply. Shears plates up to ⅜ in. Flat bars up to 1 in. by 6 in., rounds up to 2¼ in., square bars up to 2 in. by 2 in. Punches up to 1½ in. diameter through ⅝ in. Square notches plate up to ½ in. thick. Weight approx. 89 cwt.

HAMILTON NO. 425 DOUBLE SIDED POWER PRESS. Motorised for 400/3/50 supply. Pressure exerted approx. 100 tons. Stroke 5 in. Between uprights 42¾ in. Bed 42 in. by 32 in. Hole in bed 33 in. by 20½ in. Weight approx. 6 tons.

DOUBLE SIDED FRICTION SCREW PRESS. Motorised for 400-440/3/50 supply. Pressure exerted 50 tons. Stroke 9 in. Between uprights 15½ in. Bed 15½ in. by 20 in. Hole in bed 4½ in. diameter. Weight approx. 71 cwt.

FROST POWER GEARED SWING BEAM HIGH LIFT UNIVERSAL FOLDING MACHINE. Motorised for 400-440/3/50 supply. Capacity 10 ft. by ⅜ in. mild steel. Adjustable for sharp and round bends. Clamping beam swings out for removal of trunk sections. With adjustable back gauge. Weight approx. 6 tons. Photographs of the above are available. Very favourable Hire Purchase terms can be obtained.

MACHINE TOOLS, NEW AND USED,
Of Every Description. Attractive Prices.

F. J. EDWARDS LTD.
359-361, EUSTON ROAD,
LONDON, N.W.1.
Telephone: EUSton 5000. Telex 24264.
And at
LANSDOWNE HOUSE, 41, WATER STREET,
BIRMINGHAM, 3.
Telephone: Central 7606-8. G 876

For 'Engineering' Appointments Section, turn to the centre of editorial section.

TRADE AND TECHNICAL
CONTINUED

CONSULTANTS & EXPERIMENTAL WORK

PLINT & PARTNERS LTD.
Blakes Road, Wargrave, Berks.
Tel: Wargrave 407
MECHANICAL ENGINEERS
investigate research problems and design and manufacture equipment for
RESEARCH & DEVELOPMENT INSTRUCTION G 776

NORRIS BROS. LTD.,
53 VICTORIA ST., LONDON, S.W.1.
Tel.: ABBey 6132,
and at Burgess Hill, Sussex.
Specialists in
RESEARCH, DESIGN, DETAILING AND DEVELOPMENT
throughout the whole of the Engineering Industry
G 900

EXPERIMENTAL
and
DEVELOPMENT WORK
PROTOTYPES
DESIGN, MANUFACTURE AND TEST
SPECIAL PURPOSE MACHINES
PRECISION ENGINEERING FROM SMALL SCIENTIFIC INSTRUMENTS TO MACHINES AND APPARATUS OF SEVERAL TONS
OVER 30 YEARS EXPERIENCE
A.I.D. AND A.R.B. APPROVED
RESEARCH ENGINEERS LIMITED
NORTHAMPTON GROVE, CANONBURY, N.1
CAN 4244/5/6 G 878

DISMANTLERS

For factory dismantling the
MAYER, NEWMAN SYSTEM
Scrap Iron & Steel Clearance
MAYER, NEWMAN & CO. LTD.
Arundel House, Arundel Street, London, W.C.2.
Telephone: TEMple Bar 9711. G 850

VALECTRIC REGD.

The photograph shows a series of No. 3 Valectrics *installed at L.C.C. Northern Outfall Sewage Works, Beckton. (Chief Engineer: J. Rawlinson, C.B.E.)*

VALVE ACTUATORS

'Valectric' Actuators are available for power-operation of all sizes of sluice and butterfly valves, penstocks, etc.

- **Automatic or remote control**
- **Sensitive Torque Limiter for full protection**
- **'Impact cracking' device**
- **Hand operation in cases of power failure**
- **Readily adapted to existing valves**

No. 3 Valectric

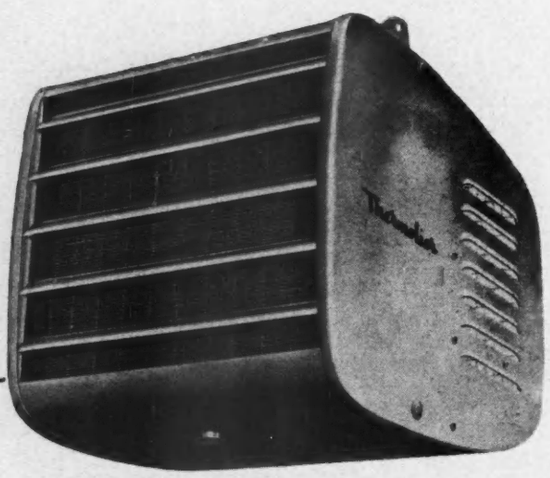
Send for Publication P.12 (G)

HARTLEYS (STOKE-ON-TRENT) LTD.

Head Office and Works: Kearsley Chambers, Stoke-on-Trent. Tel: 48627
London Office: Hastings House, Norfolk St., Strand, W.C.2. Tel.: TEMple Bar 5705

The NEW THERMOLIER unit heater

Registered Design No. 888398



The New Thermolier Unit Heater, employing steam or accelerated hot water, provides heat exactly where and when it is required.

Warm air directed to working level maintains a comfortable temperature and constant circulation prevents stagnation.

Thermolier Unit Heaters can be installed without sacrifice of floor space and without extensive structural alterations.

★ **IMPROVED PERFORMANCE**

★ **MODERN DESIGN**

Mather & Platt LIMITED

PARK WORKS, MANCHESTER, 10

Telephone: COLlyhurst 2321 *Telegrams: Sprinkler, Manchester*

DENISON

High Temperature

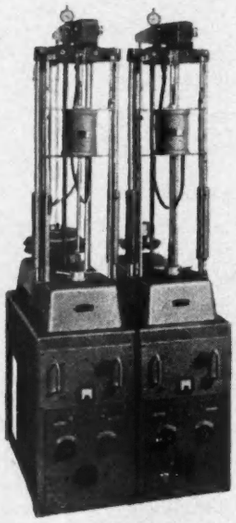
CREEP TESTING EQUIPMENT

ACCURACY—all are High sensitivity machines

CONTROLS—Latest Saturable reactor type proportional temperature controllers with platinum resistance thermometers

FURNACES—of lengths to accommodate single or multi-specimens

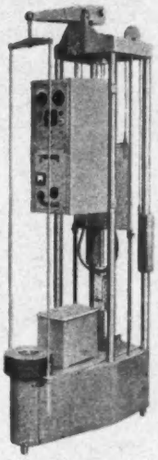
AUTOMATIC—Model T.48 Automatically applies load as extension takes place and unwinds load in the event of electrical or furnace failure



MODEL T.47E
Capacity 1 ton

MODEL T.45A Capacities
5 tons and 15 tons

MODEL T.48
Capacity 3 tons



Please let us have full details of your requirements, stating specimen dimensions, temperature range, anticipated elongation and loads to be applied.

SAML. DENISON & SON LTD.

HUNSLET FOUNDRY · MOOR ROAD · LEEDS 10
Tel: Leeds 7-5488 Grams: 'Weigh Leeds 10'

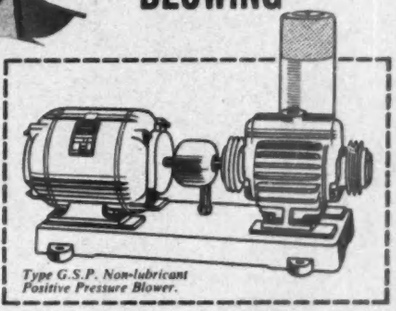
Area Offices at LONDON SLOane 4628 · BIRMINGHAM Midland 3931 · MANCHESTER Blackfriars 1906 · LEEDS Leeds 2-8433

I MUST HAVE REALLY EFFICIENT POSITIVE PRESSURE BLOWING

For positive pressures up to 10 lb. per sq. in. from approx. 240 to 16,000 c.f.h. Belt driven or motorised. A number of the machines can now be supplied non-lubricant up to 10 lb. pressure. Water-cooled machines for pressures up to 50 lb.

"ALCOSA" products include:-

Positive Pressure Blowers; Brazing Equipment; Industrial Gas Equipment (including Soldering Stoves, Gas and Oil Burners and other specialised equipment); Fans—low, medium and high pressure; Furnaces—Gas or Oil fired; Forges—Hand and Electric; Specialists in Hot Brass Stamping Furnaces, Gas or Oil fired.

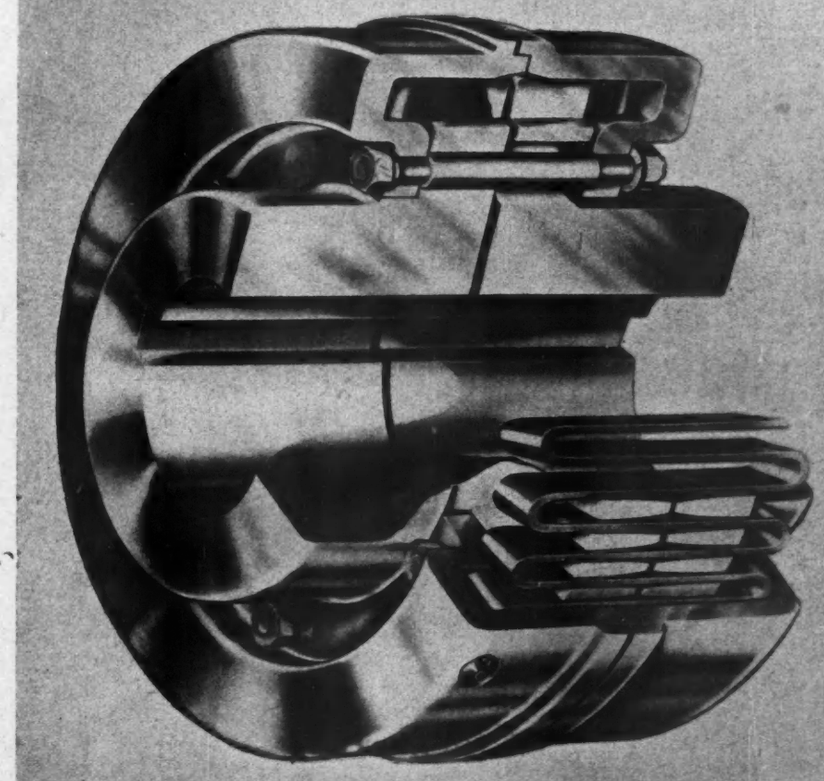


Type G.S.P. Non-lubricant Positive Pressure Blower.

...THAT'S WHY I SPECIFY ALCOSA

BRITISH PRODUCTS

WILLIAM ALLDAY AND COMPANY LIMITED
Incorporating A. H. Wilkes & Company (Industrial Gas Equipment)
Head Office: ALCOSA WORKS, STOURPORT-ON-SEVERN, WORCS.
Telephone: Stourport 2311-4 Telegrams: 'Yadall' Stourport.
London Area Office: 158 Birchanger Road, South Norwood S.E. 25. Telephone: Addiscombe 1162 & 1295



The BIBBY *Resilient* COUPLING

World famous for outstanding performance and reliability. Made in a wide range of types, all employing the same basic principle of Bibby design.

Special types include: Brakewheel, Cardan Shaft, Turbine, Shear pin, Controlled Torque, Spacer and others.

THE WELLMAN BIBBY COMPANY LIMITED, PARNELL HOUSE, WILTON ROAD, LONDON, S.W.1

Automatic CONTROL

for centreless bar turning machine

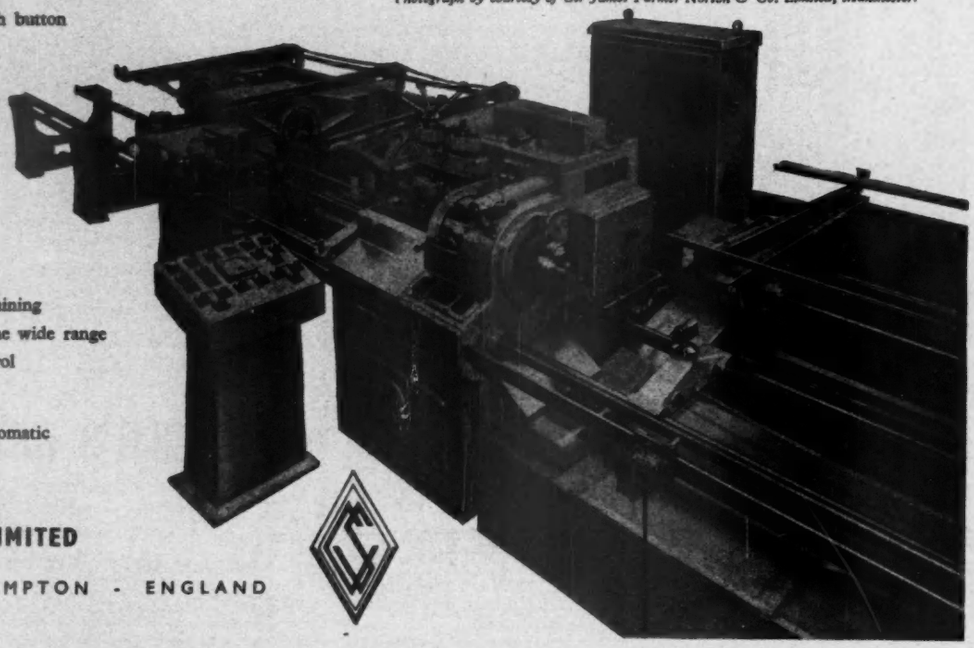
Photograph by courtesy of Sir James Farmer Norton & Co. Limited, Manchester.

The operating pedestal and its associate push button stations provide compact finger tip control of the machine's operation whilst maintaining full vision of production.

Remote automatic operation as shown, enables the contactor panel to be mounted in a non obstructing, yet accessible position.

The panel with its robust construction containing components for arduous duty is typical of the wide range of machine tool and heavy engineering control experience our service affords.

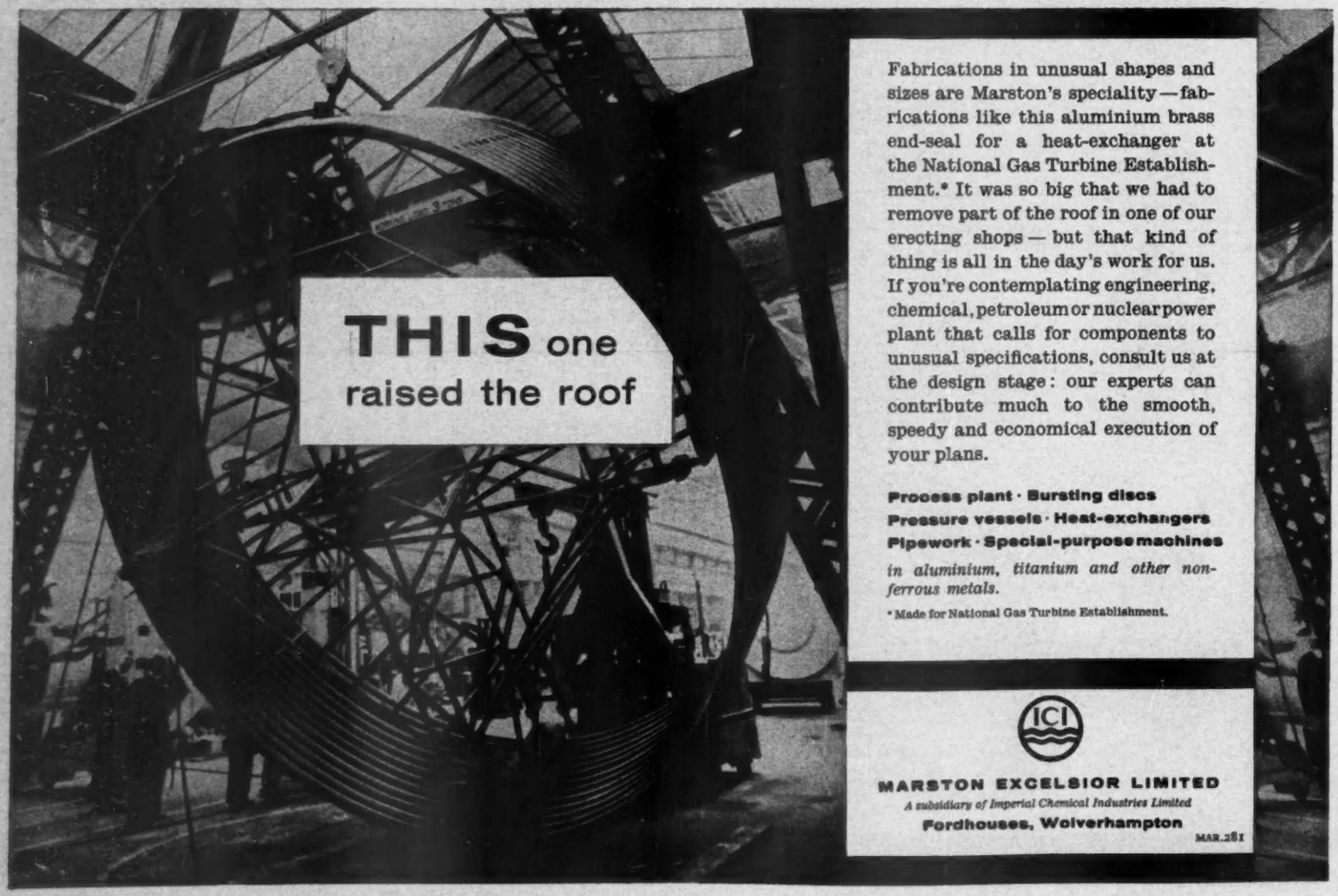
May we quote you for all types of fully automatic control gear?



CONTACTOR SWITCHGEAR LIMITED

BLAKENHALL · WOLVERHAMPTON · ENGLAND

Telephone: Wolverhampton 25911/7.
Telegrams: Tactorgear Wolverhampton.



Fabrications in unusual shapes and sizes are Marston's speciality—fabrications like this aluminium brass end-seal for a heat-exchanger at the National Gas Turbine Establishment.* It was so big that we had to remove part of the roof in one of our erecting shops — but that kind of thing is all in the day's work for us. If you're contemplating engineering, chemical, petroleum or nuclear power plant that calls for components to unusual specifications, consult us at the design stage: our experts can contribute much to the smooth, speedy and economical execution of your plans.

Process plant · Bursting discs
Pressure vessels · Heat-exchangers
Pipework · Special-purpose machines
in aluminium, titanium and other non-ferrous metals.

* Made for National Gas Turbine Establishment.

MARSTON EXCELSIOR LIMITED
A subsidiary of Imperial Chemical Industries Limited
Fordhouses, Wolverhampton
MAR.281

Richards Double Column Planing and Milling Machine, recently installed at the Trafford Park Factory of Associated Electrical Industries (Manchester) Limited, is illustrated here milling a horizontal joint of the upper half of an I.P. outer cylinder, weighing 11½ tons, for a 200 M.W. Turbine being made for the C.E.G.B. The machine has a worktable, in which is incorporated hydrostatic lubrication, measuring 32ft. long, 13ft. wide and a working height of 10ft. together with a table stroke of 32ft. and a work loading capacity of 50 tons. It is equipped with two tool boxes and a motorized Milling Head mounted on the cross slide, and one tool box either side of the table mounted on the vertical columns. These machines are built in a range from 10ft. wide capacity and upwards with a table stroke to customers' special requirements.

RICHARDS

GEORGE RICHARDS & CO. LTD. **BROADHEATH, ALTRINCHAM, CHESHIRE**

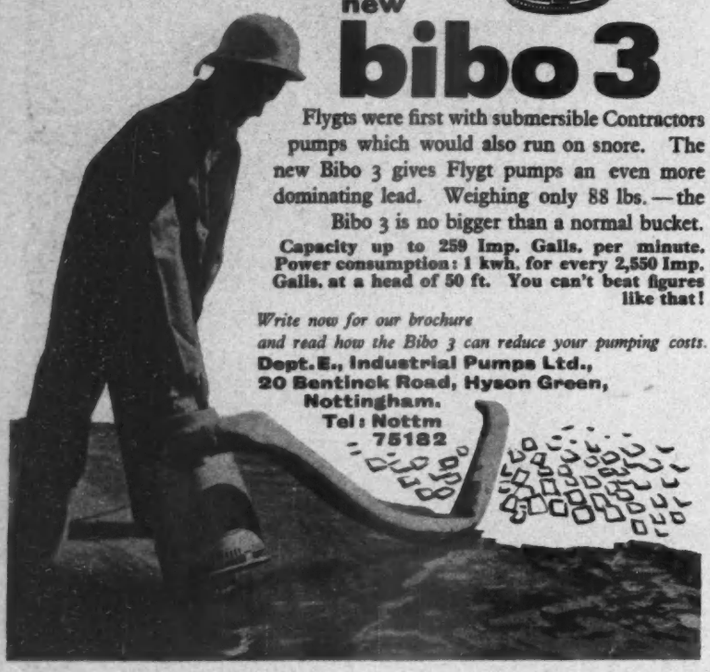
TELEPHONE: ALTRINCHAM 4242/7
SOLE AGENTS: ALFRED HERBERT LTD., TELEGRAMS: RICHARDS, ALTRINCHAM FACTORED DIVISION, COVENTRY

A Member of The Staveley Coal & Iron Co. Ltd. Group

RHS

NOW an unbeatable FLYGT pump

The new **bibo 3**



Flygts were first with submersible Contractors pumps which would also run on snore. The new Bibo 3 gives Flygt pumps an even more dominating lead. Weighing only 88 lbs. — the Bibo 3 is no bigger than a normal bucket.

Capacity up to 259 Imp. Galls. per minute. Power consumption: 1 kwh. for every 2,550 Imp. Galls. at a head of 50 ft. You can't beat figures like that!

Write now for our brochure and read how the Bibo 3 can reduce your pumping costs.

Dept. E., Industrial Pumps Ltd., 20 Bentinck Road, Hyson Green, Nottingham. Tel: Nottm 75182

Clamping for Safety

with the ODONI MACHINE BED CLAMP

An entirely new design in Machine Bed Clamps, now in use in workshops throughout the country, is making the machining of small parts easier and safer.

The Odoni Machine Bed Clamp has these features:

- **Clamps any thickness from ·001in. to 2 ½in.**
- **Fully open to fully closed in a few turns.**
- **No spanner, packings, shims or other makeshift required.**
- **Swivels in any direction without adjustment.**
- **Over ½ ton pressure can be applied.**

Supplied with bolts and heavy washers for T-slots. Base fitting tapped ⅝ in. Whitworth. Finished in grey hammer stove. Obtainable through Engineer's Merchants or direct from the manufacturers, price £2.17.6 per pair.

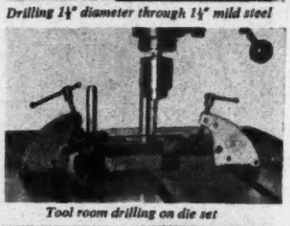
14 day FREE TRIAL

Try a pair of Odoni Machine Bed Clamps in your own Machine shop. Send us a postcard today with your name and address—we will send you a pair of clamps by return without any obligation to purchase, and at no cost to yourselves.

Odoni

Patents applied for in principal countries

Drilling 1¼" diameter through 1½" mild steel



Tool room drilling on die set

Precision milling on rotary table

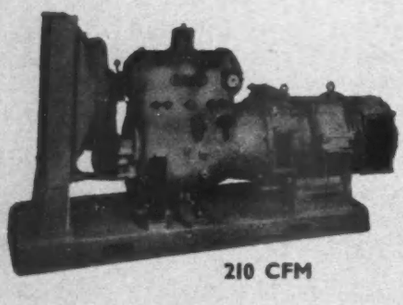
ODONI EQUIPMENT LIMITED (DEPT. 56)
79-85 SCRUBS LANE, LONDON, N.W.10 telephone LADBROKE 2948

how many people know?...

600 CFM

That the Hydrovane Compressor in relation to the reciprocating or rotary compressor is more compact • Has fewer working parts • Supplies oil-free air at much lower temperatures than previously obtainable • light and self-contained • Is low in point consumption and low in initial cost.

These and many other answers to questions are given in an interesting booklet available on request.



210 CFM

WHITTAKER HALL
& CO. (1929) LTD

Black Lane Works, Radcliffe, Lancashire. *Telephone RADcliffe 2421*
London: 119 Victoria Street, London, S.W.1. *Telephone VICtoria 2612*
Birmingham: Exchange Buildings, Birmingham 2. *MIDland 2257*
Glasgow: Vernon House, Dalziel Drive, S.1. *IBROX 2597*
Liverpool: Tower Buildings, Liverpool *Liverpool CENtral 9626*

HYDROVANE
WHITTAKER HALL

THE MORGAN CRUCIBLE COMPANY LTD.

AND

BRITISH BELTING & ASBESTOS LTD.

announce the formation of

MORGAN-MINTEX LIMITED

Morgan-Mintex Ltd., will manufacture "SINTERLINK", sintered friction materials, hitherto manufactured by The Morgan Crucible Company Ltd. "SINTERLINK" will be marketed by the Mintex Division of British Belting & Asbestos Ltd. Cleckheaton, Yorkshire, to whom all enquiries should be addressed.

MORGAN-MINTEX LIMITED

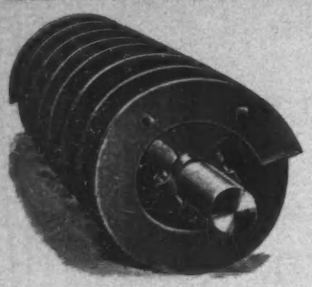
POINT PLEASANT, WANDSWORTH, LONDON, S.W.18

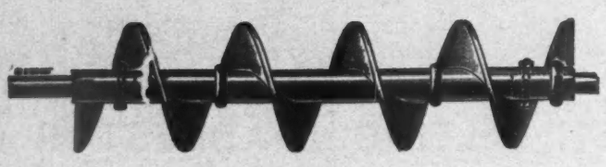
Registered Office: Northfields, Wandsworth, S.W.18

CONVEYOR AND ELEVATOR Co (1936) LTD.

BULL BRIDGE WORKS
Accrington, Lancashire

Telephone No. 2771
Telegrams "Conveyor," Accrington

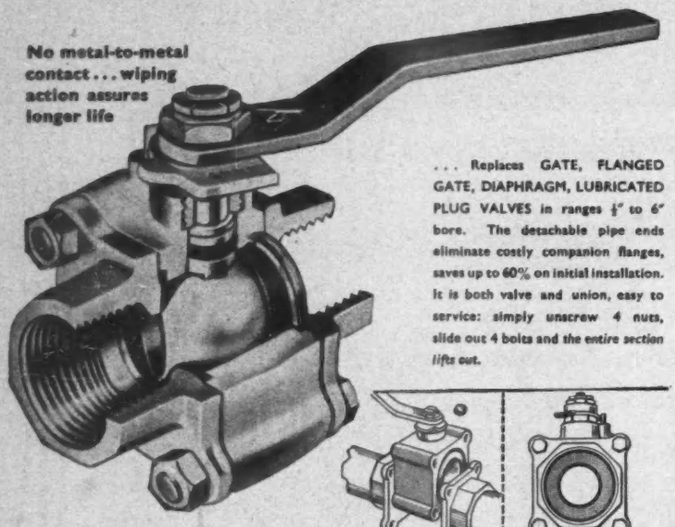




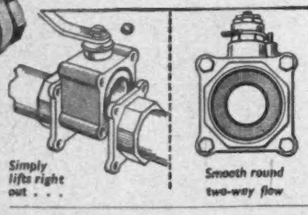
SPIRAL CONVEYORS,
BUCKET ELEVATORS, Etc.

Compare the
'WORCESTER' BALL VALVE
with any other ON-OFF valve!

No metal-to-metal contact... wiping action assures longer life



... Replaces GATE, FLANGED GATE, DIAPHRAGM, LUBRICATED PLUG VALVES in ranges ¼" to 6" bore. The detachable pipe ends eliminate costly companion flanges, saves up to 60% on initial installation. It is both valve and union, easy to service: simply unscrew 4 nuts, slide out 4 bolts and the *entire section lifts out.*



Simply lifts right out . . .

Smooth round two-way flow

Send for all particulars to:-

THE WORCESTER VALVE CO., LTD.
62 CHURCH ROAD · BURGESS HILL · SUSSEX · Telephone 85678

Northey
ROTARY COMPRESSORS LTD.

'OIL FREE'
COMPRESSORS AND VACUUM PUMPS

DESIGNED FOR SPECIALISED SERVICE IN INDUSTRY
Northey Positive Rotary Compressors and Vacuum Pumps are precision made machines noted for their "OIL FREE" feature, simplicity and reliability.

ALDER ROAD · PARKSTONE · POOLE · DORSET
TELEPHONE PARKSTONE 4900 (2 LINES)

ESTABLISHED 1825

COPPER PLANT

BLUNDELL & CROMPTON
LIMITED

Over a century of experience in engineering, prototype work and manufacturing of plant for the chemical industry, etc.

WEST INDIA DOCK ROAD · LONDON, E.14.
Telephone: EAST 3838 (3 lines), 1408 & 4160 · Telegrams: Blundell, Phone, London.

PRESSURE and VACUUM RELIEF VALVES

The Controlling Influence

Have you ever stopped to think what your Controls are costing you? Production Control, Stock Control, Sales Control, Budgetry Control.

Can you, for example, change 500 stock balances per hour *with one clerk*? Or list 1,000 stock balances in 10 seconds? Or survey the machine shop loadings and progress of orders in one visual examination?

The Planomatic Plan for Management is effecting just such startling Controls for leading manufacturers everywhere. It is the most flexible system yet evolved, providing a co-ordinated flow of information throughout an organisation in a simple dynamic form.

It is part of modern business—make it a part of yours, too.

More information, please, about the PLANOMATIC PLAN FOR MANAGEMENT—without obligation.

NAME.....

COMPANY.....

ADDRESS.....

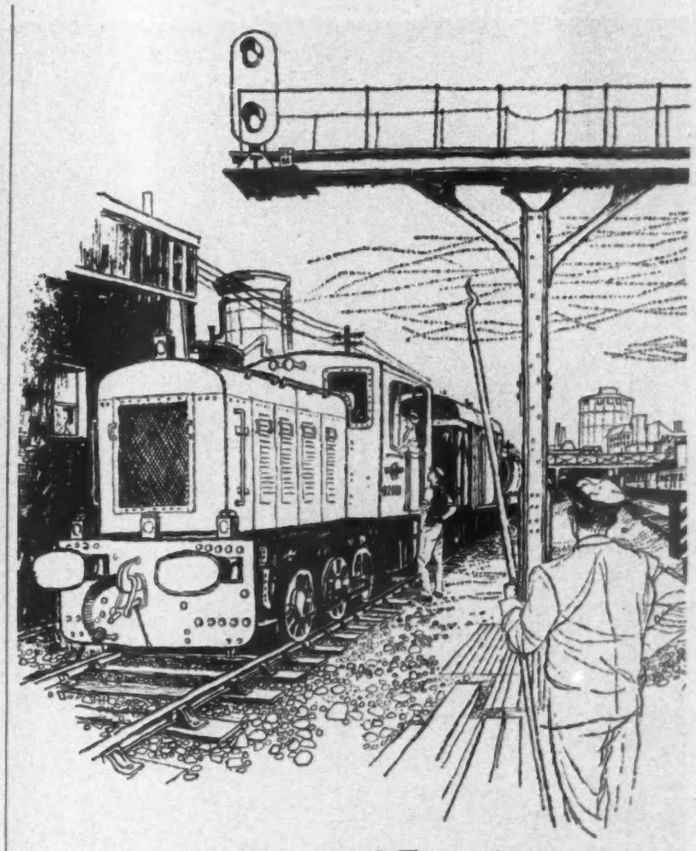
.....23

Ask your Secretary to send the coupon for more information.

THE PLANOMATIC PLAN FOR MANAGEMENT

Dacron (Plan-o-Matic) Limited · 32 Fitzroy Square · London W.1.

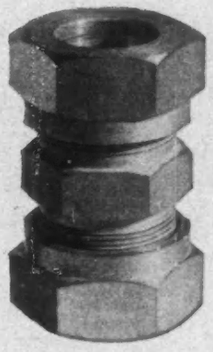
Telephone: EUSton 5741



the applications of Ermeto high pressure couplings are practically unlimited

Where conditions are severe and dependability vital, there you may safely specify Ermeto high pressure couplings and flexible hose, for hydraulic, air and steam lines. These couplings are supplied in a wide range of standard fittings. Non-standard fittings can also be supplied to meet your specifications.

Technical information and our illustrated catalogue are freely available on request.



ERMETO

BRITISH ERMETO CORPORATION LTD

HARGRAVE ROAD · MAIDENHEAD BERKS · TELEPHONE: MAIDENHEAD 6100

A member of the ALENCO Group of Companies

The Nitriding Process for Case-hardening Special Steels by Nitrogen offers

- Surface hardness up to 1100 D.P.H.
- Retention of full hardness after heating to 500°C.
- Maximum resistance to frictional wear and fatigue.
- Improved resistance to corrosion by water and steam.

Particulars from:—

NITRALLOY LIMITED

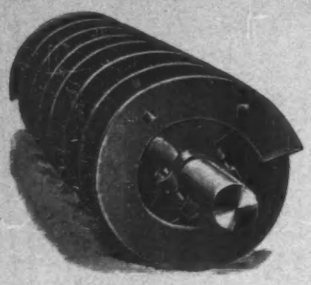
ATLAS WORKS, SHEFFIELD, 4.

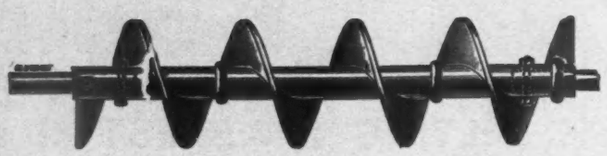
Telephone: Sheffield 26646. Telegrams: "NITRALLOY, SHEFFIELD."

CONVEYOR AND ELEVATOR Co (1936) LTD.

BULL BRIDGE WORKS
Accrington, Lancashire

Telephone No. 2771
Telegrams "Conveyor," Accrington

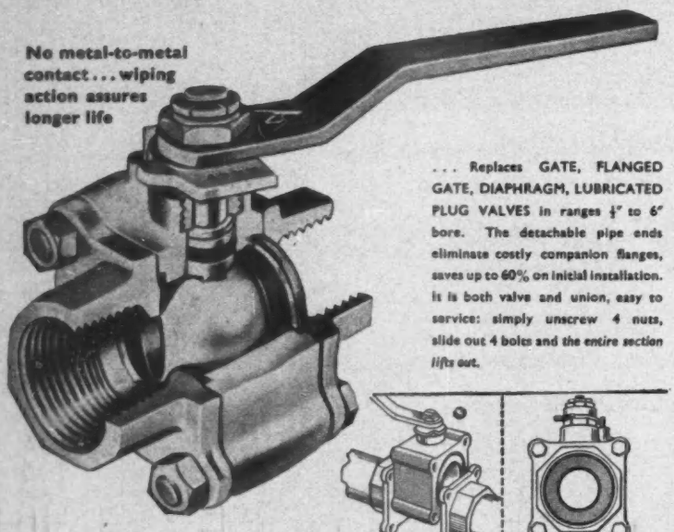




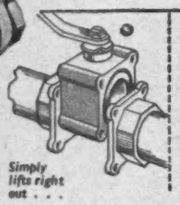
SPIRAL CONVEYORS,
BUCKET ELEVATORS, Etc.

Compare the
'WORCESTER' BALL VALVE
with any other ON-OFF valve!

No metal-to-metal contact . . . wiping action assures longer life



. . . Replaces GATE, FLANGED GATE, DIAPHRAGM, LUBRICATED PLUG VALVES in ranges ¼" to 6" bore. The detachable pipe ends eliminate costly companion flanges, saves up to 60% on initial installation. It is both valve and union, easy to service: simply unscrew 4 nuts, slide out 4 bolts and the *entire section lifts out.*



Simply lifts right out . . .

Smooth round two-way flow

Send for all particulars to:-

THE WORCESTER VALVE CO., LTD.
62 CHURCH ROAD · BURGESS HILL · SUSSEX · Telephone 85678

Northey
ROTARY COMPRESSORS LTD.

'OIL FREE' COMPRESSORS AND VACUUM PUMPS

DESIGNED FOR SPECIALISED SERVICE IN INDUSTRY
Northey Positive Rotary Compressors and Vacuum Pumps are precision made machines noted for their "OIL FREE" feature, simplicity and reliability.

ALDER ROAD · PARKSTONE · POOLE · DORSET
TELEPHONE PARKSTONE 4900 (2 LINES)

ESTABLISHED 1825

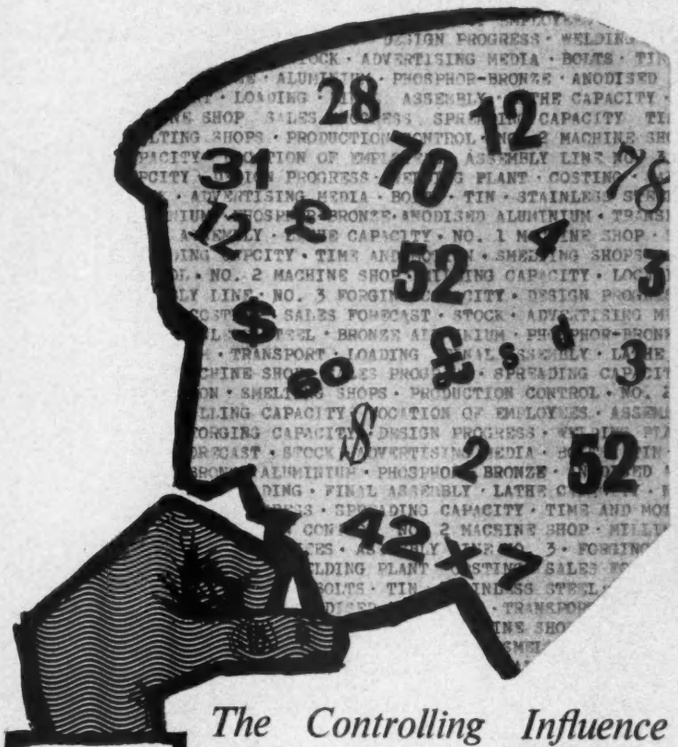
COPPER PLANT

BLUNDELL & CROMPTON
LIMITED

Over a century of experience in engineering, prototype work and manufacturing of plant for the chemical industry, etc.

WEST INDIA DOCK ROAD · LONDON, E.14.
Telephone: EAST 3838 (3 lines), 1408 & 4160 · Telegrams: Blundell, Phone, London.

PRESSURE and VACUUM RELIEF VALVES



The Controlling Influence

Have you ever stopped to think what your Controls are costing you? Production Control, Stock Control, Sales Control, Budgetry Control.

Can you, for example, change 500 stock balances per hour *with one clerk*? Or list 1,000 stock balances in 10 seconds? Or survey the machine shop loadings and progress of orders in one visual examination?

The Planomatic Plan for Management is effecting just such startling Controls for leading manufacturers everywhere. It is the most flexible system yet evolved, providing a co-ordinated flow of information throughout an organisation in a simple dynamic form.

It is part of modern business—make it a part of yours, too.

More information, please, about the PLANOMATIC PLAN FOR MANAGEMENT—without obligation.

NAME.....

COMPANY.....

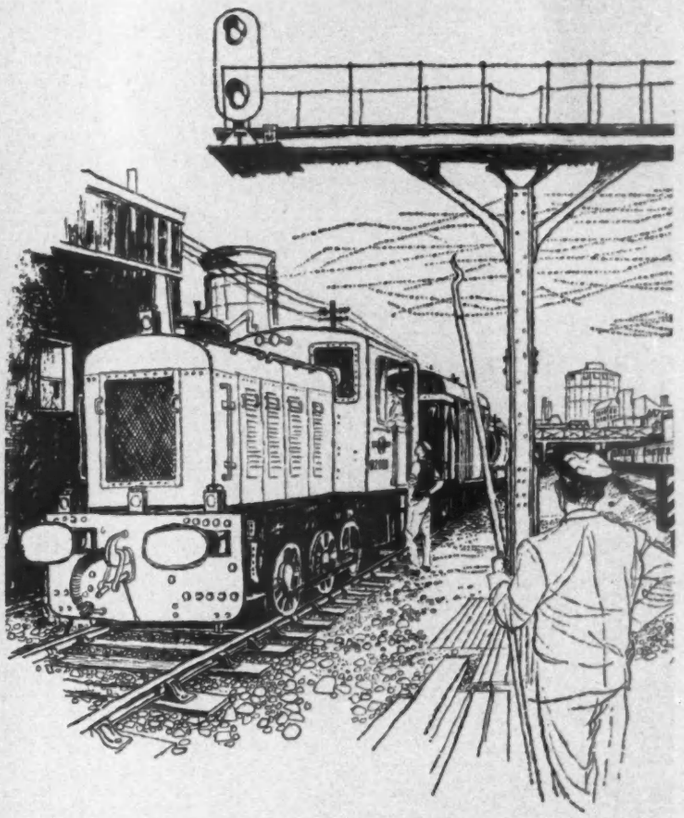
ADDRESS.....22

Ask your Secretary to send the coupon for more information.

THE PLANOMATIC PLAN FOR MANAGEMENT

Dacron (Plan-o-Matic) Limited · 32 Fitzroy Square · London W.1.

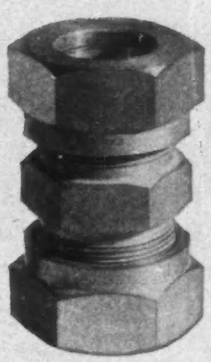
Telephone: EUSton 5741



the applications of Ermeto high pressure couplings are practically unlimited

Where conditions are severe and dependability vital, there you may safely specify Ermeto high pressure couplings and flexible hose, for hydraulic, air and steam lines. These couplings are supplied in a wide range of standard fittings. Non-standard fittings can also be supplied to meet your specifications.

Technical information and our illustrated catalogue are freely available on request.



ERMETO

BRITISH ERMETO CORPORATION LTD

HARGRAVE ROAD · MAIDENHEAD BERKS · TELEPHONE: MAIDENHEAD 5100

A member of the ALENCO Group of Companies

The Nitriding Process for Case-hardening Special Steels by Nitrogen offers

- Surface hardness up to 1100 D.P.H.
- Retention of full hardness after heating to 500°C.
- Maximum resistance to frictional wear and fatigue.
- Improved resistance to corrosion by water and steam.

Particulars from:—

NITRALLOY LIMITED

ATLAS WORKS, SHEFFIELD, 4.

Telephone: Sheffield 26646. Telegrams: "NITRALLOY, SHEFFIELD."

ALSO AVAILABLE

SMALLER BUILDINGS
EX SITE

STEEL FRAMES

1. 156ft. long, 35ft. 6in. wide, 12ft. 6in. floor to eaves. 19ft. 6in. floor to ridge.
13 trusses on 6in. by 5in. R.S. Joists.
Roof lights full length one side in 7ft. cast wired glass.
Window casements both sides. Sliding doors on one side. Lighting fittings.
Ideal boiler, nine sections, K 47.

1. 289ft. long, 35ft. wide, 9ft. floor to eaves. 16ft. floor to ridge, 25 trusses on 6in. by 4½in. R.S. Stanchions.

1. 65ft. long, 35ft. wide, 9ft. to eaves. 16ft. floor to ridge, 5 trusses on 6in. by 4½in. R.S. Stanchions.
Window casements along one side.

1. 60ft. long, 35ft. 3in. wide, 8ft. 10in. floor to eaves, 15ft. 10in. floor to ridge. 6 trusses on 6in. by 4½in. R.S. stanchions. Heating units and light fittings available.

PORTAL FRAME

1. 137ft. long, 30ft. wide, 13ft. 6in. floor to eaves, 18ft. 4in. floor to ridge. 6 stanchions and rafters 9in. by 4in. R.S. Joists.

May be inspected by appointment on site at Edgware, London.

All steel is in first-class condition and will be carefully dismantled and marked for re-erection.

Prices either loaded Edgware, London, or delivered to buyer's site.

Further particulars on application.

THE 600 GROUP OF COMPANIES

STEEL FRAMED BUILDING

COVERING 91,220 SQUARE FEET

In five bays, each of 50 ft. span with Heating Equipment

DIMENSIONS:

365ft. long, 250ft. 6in. wide, 13ft. floor to eaves, 24ft. 2in. to ridge.
Perimeter Stanchions: 6in. by 5in. R.S. Joists.
Internal Stanchions: 8in. by 5in. R.S. Joists.
Trusses: M.S. angles, bolted/riveted constructions.
Purlin: M.S. angles.
Roof Lights: full lengths one side each bay in 7ft. cast wired glass.
Roof Covering: ' Bix Six ' asbestos.

GEORGE COHEN

SONS AND COMPANY LIMITED

Established 1834

RAW MATERIALS DIVISION

WOOD LANE, LONDON, W.12

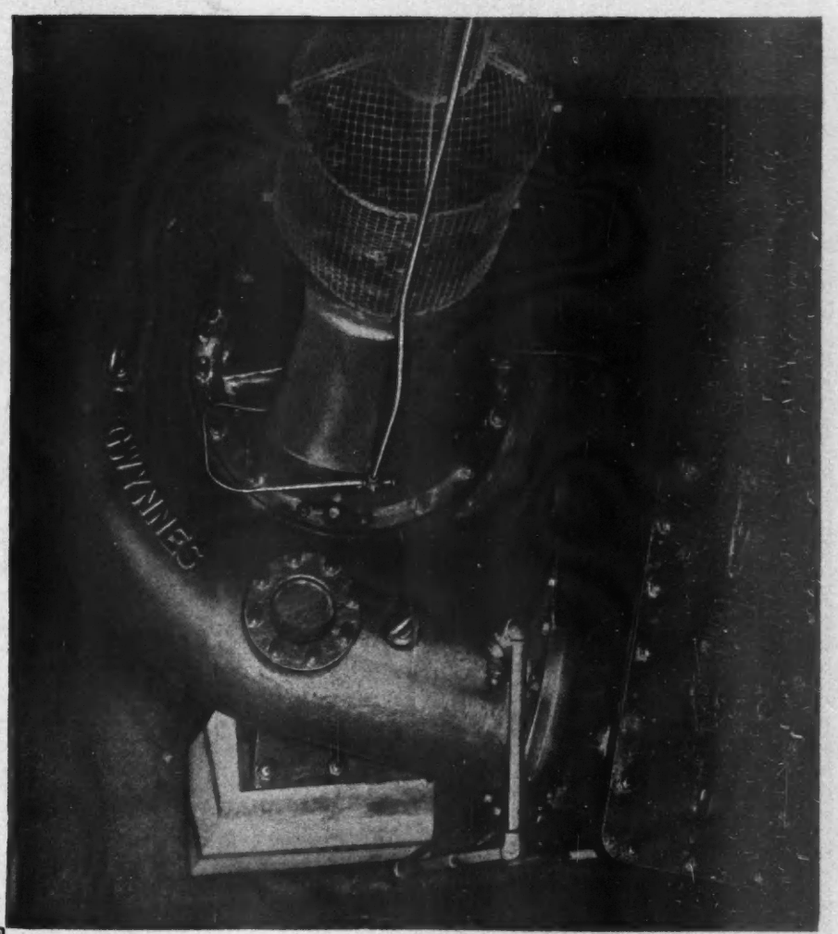
Telephone: Shepherds Bush 2070 Telegrams: Coborn, London

Gwynnes

Sewage and Storm Water Pumps

from 3″ size upwards

The photograph shows a 16″ vertical spindle storm water pump supplied to the Borough of Taunton.



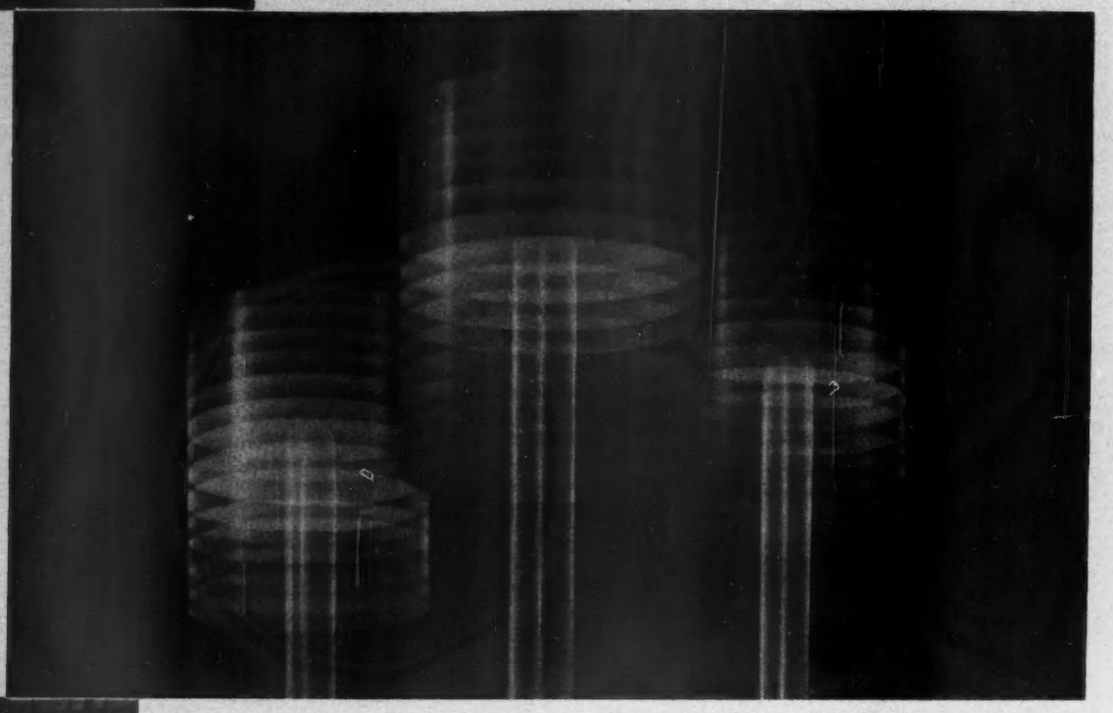
Consulting Engineer:
A. H. S. Waters, Esq.

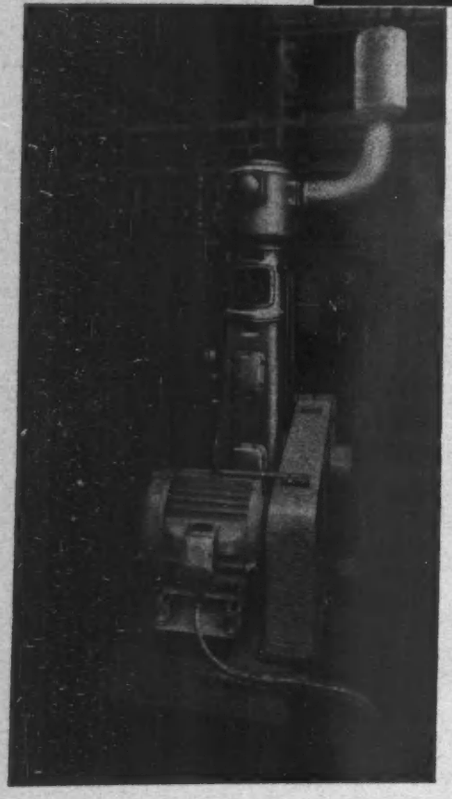
GWYNNES PUMPS

GWYNNES PUMPS LTD
HAMMERSMITH · LONDON W.6
Telephone: RIVerside 3682 (4 lines)
Telegrams: Gwynne · Hammer · London

Centrifugal, Mixed flow, Axial flow, Single and Multi-stage, Vertical and Horizontal Spindle pumps for all purposes.

SULZER





Oilfree Labyrinth Compressors

Sulzer Dry-Piston compressors are suitable for all gases and have many advantages over the conventional lubricated reciprocating compressors. Gas cannot be contaminated. Chlorine compressor photographed by kind permission of Imperial Chemical Industries Limited.

SULZER BROS. (LONDON) LTD.
31, Bedford Square, London, W.C.1
Telephone : MUSeum 7890

NO MAINTENANCE FOR 6 YEARS IN THE WETTEST CLIMATE IN ENGLAND

The Alston Foundry Company Limited, of Cumberland, say: ***"The *bridge is perpetually exposed to the elements, the action of which has had absolutely no effect whatever on the installation . . . there have been no appreciable signs of wear and it has never been necessary to carry out any form of maintenance to the bridge walkway in the period under review."***

ALAFLOR

*They were referring to a bridge which, since its installation, has carried tens of thousands of people, in heavy industrial footwear, in the worst weather in England. An ALAFLOR installation, of course! The illustration shows the ALAFLOR bridge after 6 years.

EXTRUDED ALUMINIUM FLOORING AND TREADS

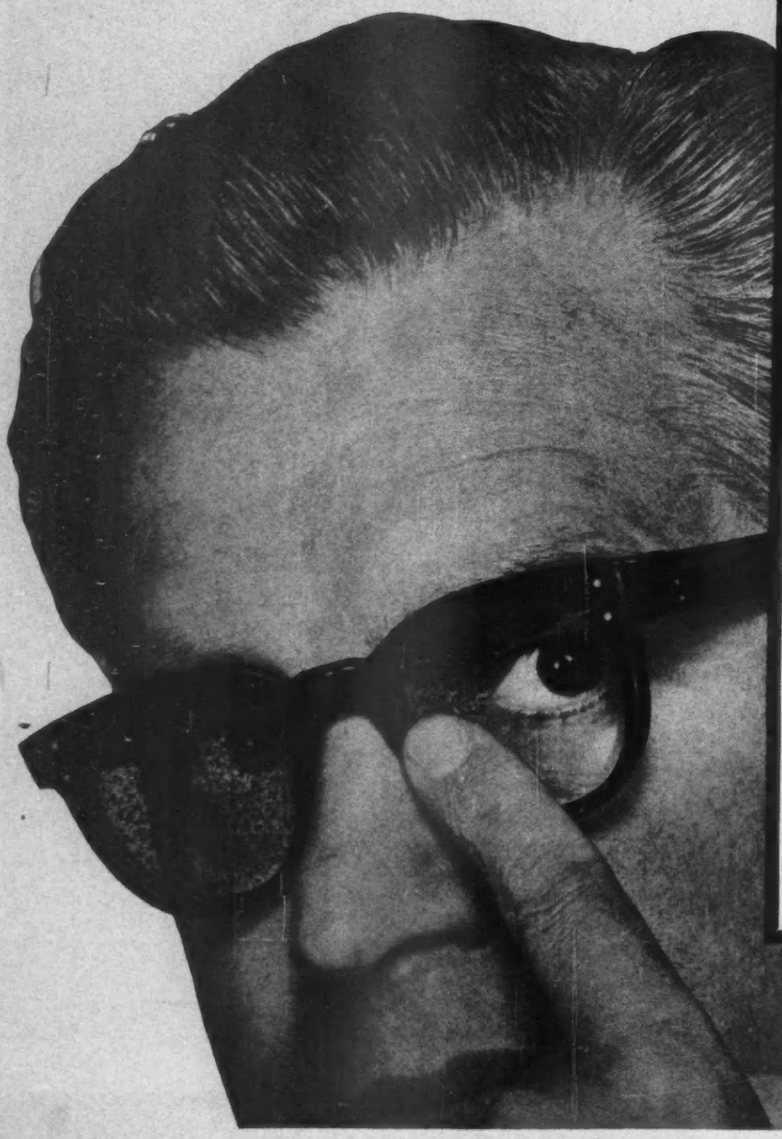
ARCHIBALD LOW & SONS LIMITED

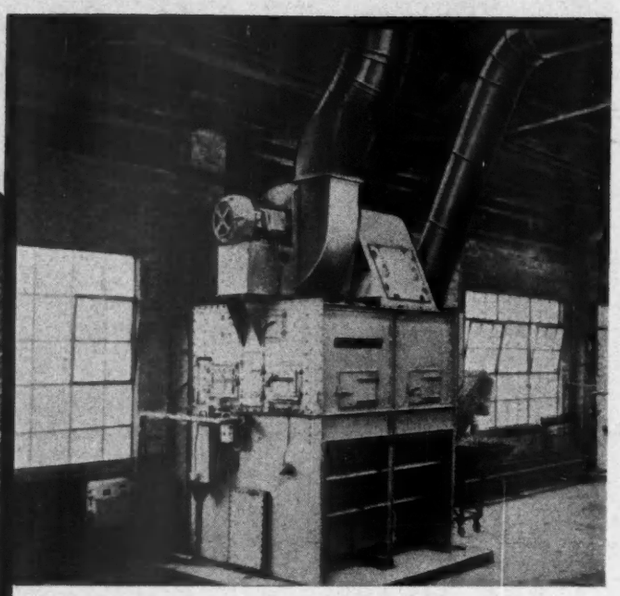
KIRKINTILLOCH SCOTLAND • HOME & OVERSEAS SALES OFFICE 143 SLOANE STREET LONDON S.W.1. TEL: SLOane 6178 756

see us for dust

Machines have become more complicated, and dusts more varied
in size and nature, but all along the line we've more than kept pace
in the design and construction of equipment to control dust.
Our current range runs from small self-contained units
to large tailor-made installations for wet or dry collection systems.

DALLOW LAMBERT





This is a Dallow Lambert Wet Deduster

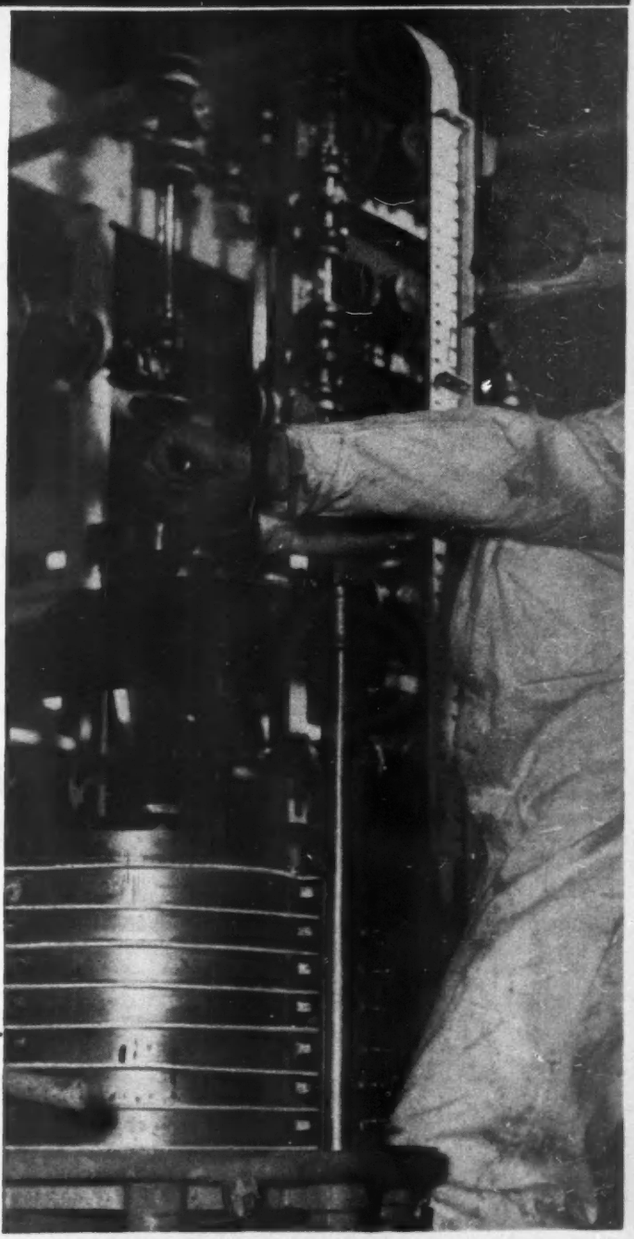
It gives complete control of a variety of dusts, making them easily disposable in sludge form. Wet dedusters are essential, of course, for the collection of some explosive dusts. Write to us for a catalogue.

DALLOW LAMBERT LIMITED · THURMASTON · LEICESTER · TELEPHONE: SYSTON 3333 (7 LINES)
CRC 91

PLATINUM METALS ARE INDUSTRIAL METALS

OFFERING THESE OUTSTANDING PROPERTIES

Peak Catalytic Activity
High Temperature Stability
Exceptional Chemical Inertness
Superior Wear Resistance
Low Vapour Pressure



A big output of antibiotics with no product contamination; that was the catalyst problem faced by The Lederle Laboratories Division of Cyanamid of Great Britain Limited. They solved it by using a platinum metals catalyst.

The Platinum Metals, platinum, palladium, rhodium and ruthenium, possess peak catalytic activity. Many hydrogenation, oxidation, dehydrogenation and dehalogenation reactions can be initiated and speeded up with economy by using a Platinum Metals catalyst.

✻ PLATINUM · PALLADIUM · RHODIUM
RUTHENIUM · IRIDIUM · OSMIUM

Engelhard Industries Limited fabricate and market the Platinum Metals refined by The Mond Nickel Company Limited

Some Industrial uses of PLATINUM METALS

A platinum metal may be the *cheapest* answer to a heat or corrosion problem.

Send for this booklet to:

ENGELHARD INDUSTRIES LTD
BAKER PLATINUM DIVISION, 52 HIGH HOLBORN, LONDON WC1

TGA PM IA

'BROOMWADE'

Air Compressors & Pneumatic Tools

Increase Output,

LOWER COSTS

RB55 Road Breaker

for light and medium duties encountered by the Public Works Contractor. Can be fitted with an interchangeable pile driving head. 1350 blows per minute.

RB770 B Road Breaker

A long stroke, hard hitting tool specially designed for heaviest concrete breaking. Supplied with Swing Stirrup as illustrated or with Latch Retainer. 1050 blows per minute.

PBR Rammer

for Pavement Laying and general Earth Consolidation Work. Effectively does work equivalent to 4 to 5 men using the hand operated type.

Aro-Broomwade Pneumatic Hoist

available in 10 or 20 cwt. capacity with "Pull Cable" or "Pendant" controls.

WE2500 Dual Purpose Winch

for standard duties and pile driving. Rope Pull 2,500 lbs. Type WE 5000 also available with Rope Pull of 5000 lbs.

CB275 Rock Drill

for drilling requirements in connection with quarrying, mining, rock excavation, from plug and feather work to reasonably deep holing. 2250 blows per minute.

SEE THESE EXHIBITS AT THE

Public Works Exhibition

NOVEMBER 14—19

Stand 28

GRAND HALL, OLYMPIA

A comprehensive range of Air Compressors and Pneumatic Tools will be exhibited on Stand No. 28 at the Public Works Exhibition.

Portable, Rotary Air Compressors will be shown with outputs from 85 c.f.m. to 600 c.f.m. Among these will be a new Rotary plant delivering 85 c.f.m. at 100 lbs/sq. in. running at 2,000 r.p.m. Also type WR600, delivering 600 c.f.m. powered by a C6NFL Rolls-Royce Diesel Engine and fitted with Automotive type steering.

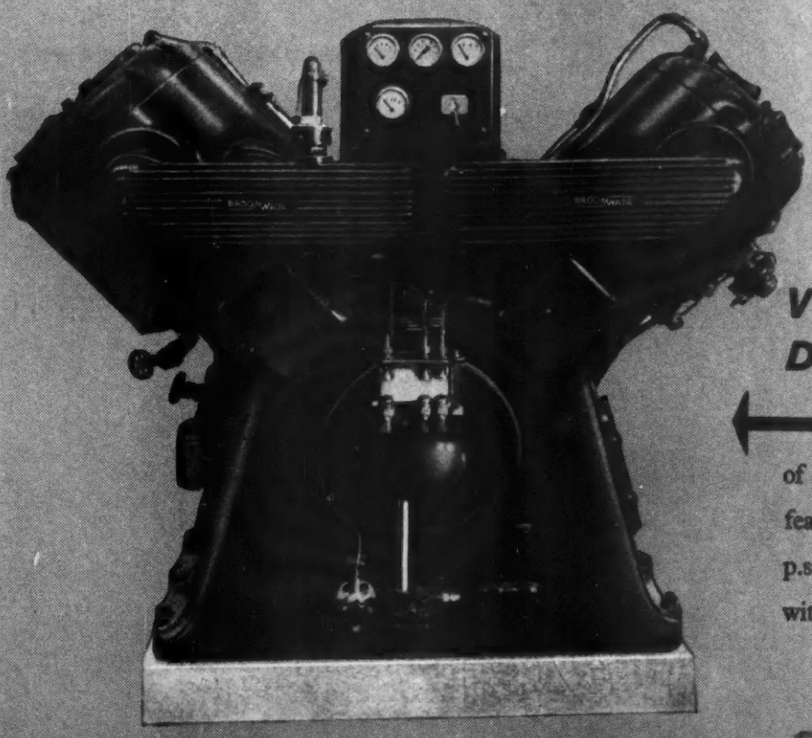
A new and very compact plant, Type P.D. 52, delivering 40 c.f.m. at 80 lbs/sq. in. will be on view.

Special attention is directed to the NEW Type V 500, Two-stage, Double-acting, self-contained, motor driven Stationary plant exhibited as a skid-mounted unit. It delivers 525 c.f.m. at 100 lbs/sq. in. Speed 485 r.p.m. A fine example of modern design, it incorporates many special refinements. In operation, it is highly efficient and reliable with a remarkable overall economy.

Pneumatic Tools on view, fully cover the requirements of Civil Engineers and Municipal Authorities.

Type "3" Sump Pump

suitable for high lifts. Weight 68 lbs. Air consumption 60 c.f.m. at 80 p.s.i. Type "5S" is also available, designed to give a greater output against delivery heads up to 40 feet.

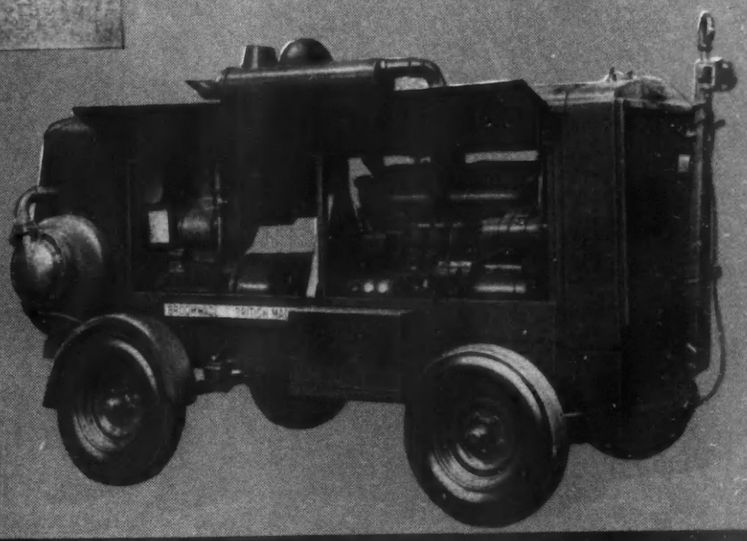


V500 Two-stage Double-Acting Compressor

of advanced design incorporating many new features. Delivery 525 c.f.m. of free air at 100 p.s.i. The "V" Type Range comprises four models with outputs from 365 to 1,000 c.f.m.

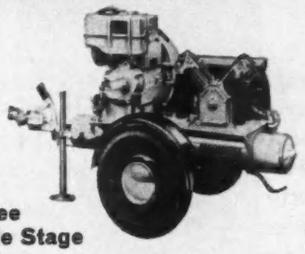
WR600 Portable Rotary Air Compressor

delivering 600 c.f.m. of free air at 100 p.s.i. normal working pressure. Incorporating automotive type steering and full trailer equipment. Rolls-Royce C6NFL Diesel Engine.



WR120 Portable Rotary Air Compressor
delivering 125 c.f.m. of free air at 100 p.s.i. normal working pressure, 4 cylinder Ford Petrol or Diesel engine.

WR380 Portable Rotary Air Compressor
delivering 380 c.f.m. of free air at 100 p.s.i. normal working pressure, mounted on four pneumatic tyred wheels with automotive type steering and full trailer equipment. Leyland UE 680 Diesel Engine.



PD52 Portable Vee Type Single Stage Compressor
delivering 40 c.f.m. of free air at 80 p.s.i. SL 2 Lister Diesel or J.A.P. Petrol engine.

"BROOMWADE"

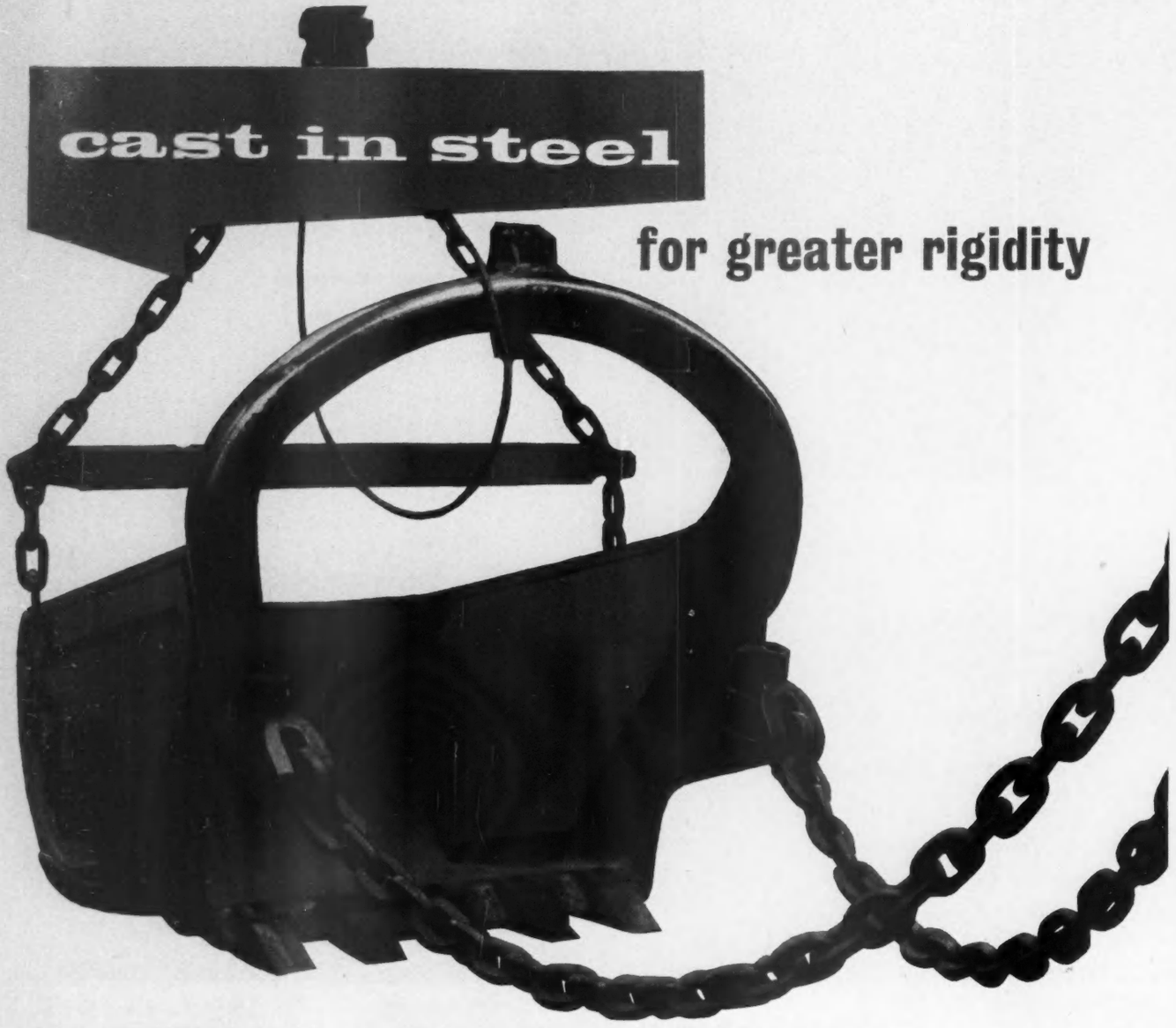
Air Compressors and Pneumatic Tools

YOUR BEST INVESTMENT

BROOM & WADE LTD., P.O. BOX No. 7, HIGH WYCOMBE, BUCKS. Telephone: High Wycombe 1630 (16 lines) Telex: 83-127
813 BAE

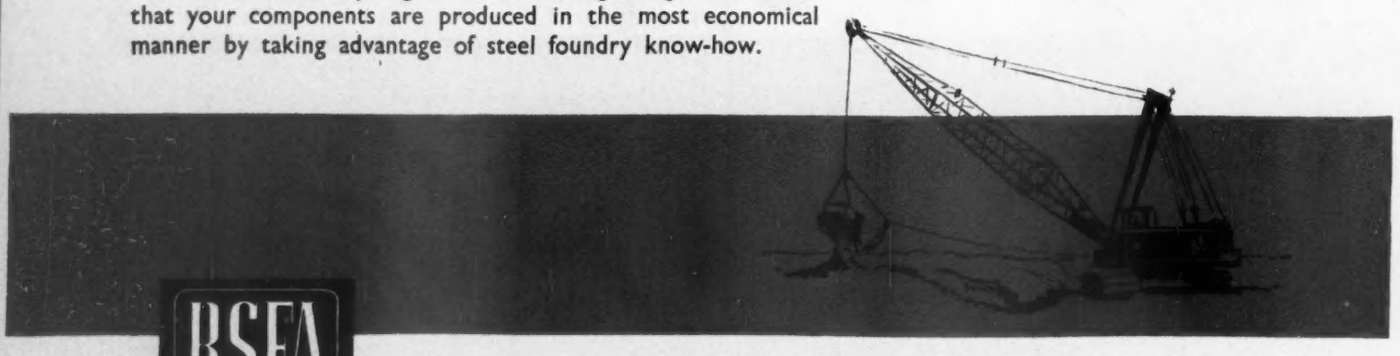
cast in steel

for greater rigidity



Dragline Bucket Arches have previously been fabricated but increase in capacity made essential the most rigid form of arch and tubular section of a shape to give the greatest rigidity and strength could be produced economically only in the foundry. Casting in steel has put metal where needed yet has eliminated useless dead weight, whilst freedom of design on parts such as the shape and contoured lips has improved efficiency.

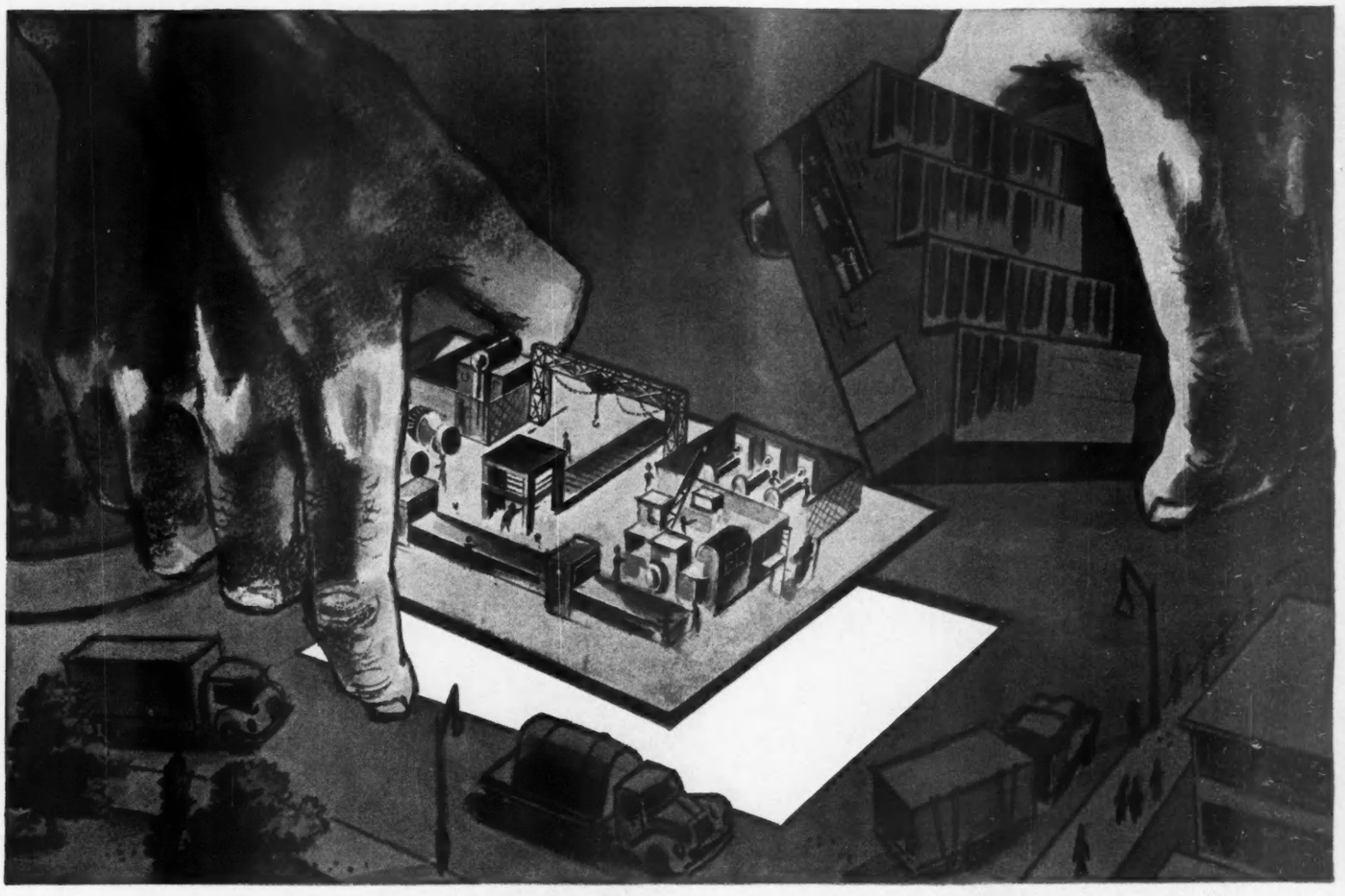
Call in a steel foundry engineer at the design stage and ensure that your components are produced in the most economical manner by taking advantage of steel foundry know-how.



BSFA
STEEL CASTINGS

THE BRITISH STEELFOUNDERS ASSOCIATION

Broomgrove Lodge, Broomgrove Rd., Sheffield



TRANSPLANTING

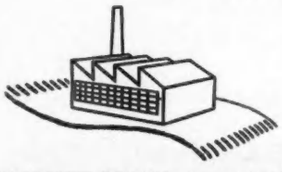
MOVING a plant is a problem to many other people than gardeners. Transferring your plant and machinery to a new site calls for considerable thought and generalship if production is not to be held up unduly. This is a very good reason why you should consult us at an early stage. We can plan and undertake the complete operation ourselves, without sub-contracting. Dismantling, packing, moving and reassembly are all done by our own expert teams.

A tyre callender dismantled and marked for packing. This plant was shipped abroad by us.

THE PLANT ENGINEERING ORGANISATION

incorporating

PLANT ENGINEERS (MECHANICAL & HANDLING) LTD.
PLANT ENGINEERS (INDUSTRIAL INSTALLATIONS) LTD.
PLANT ENGINEERS (HEATING & VENTILATING) LTD.
P.E.T. (CRANE HIRE) LTD.



The Contract Removal Specialists

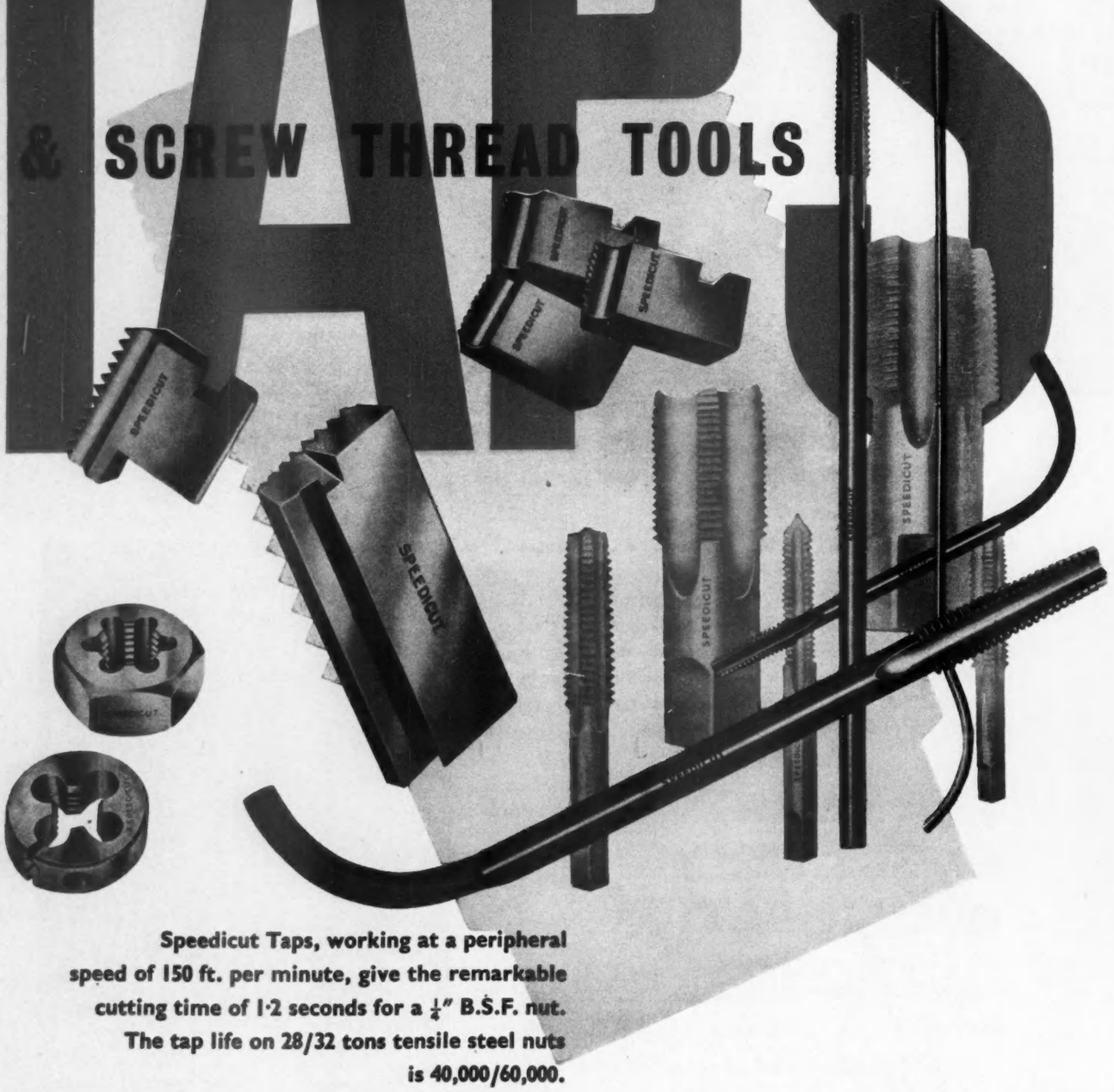
ENQUIRIES DEALT WITH IMMEDIATELY AT LONDON OFFICE (DEPT. 2.) 6 PARKWAY, CAMDEN TOWN, N.W.1. PHONE GUL 8388

C2

TAPS

SPEEDICUT

& SCREW THREAD TOOLS



Speedicut Taps, working at a peripheral speed of 150 ft. per minute, give the remarkable cutting time of 1·2 seconds for a ¼" B.S.F. nut. The tap life on 28/32 tons tensile steel nuts is 40,000/60,000.

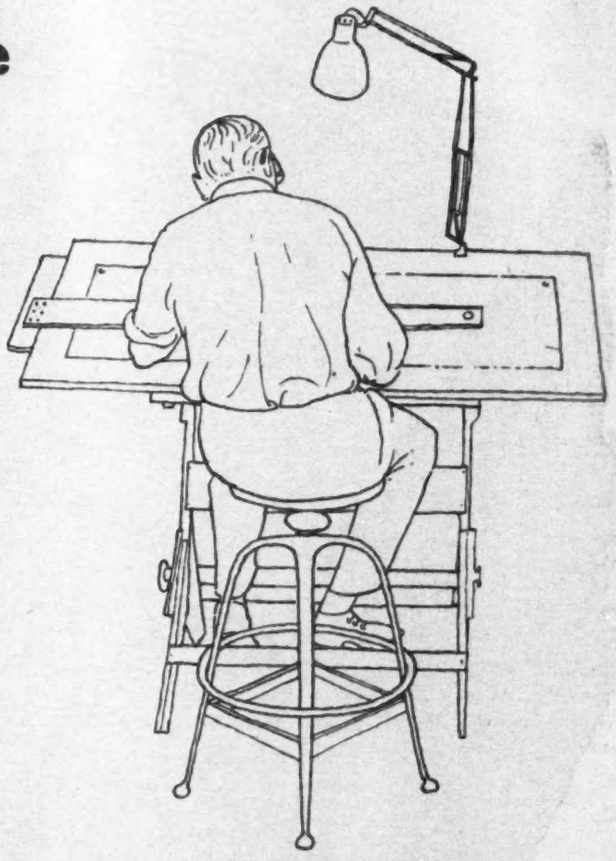
Take advantage of latest techniques in toolmaking SPECIFY SPEEDICUT.

FIRTH BROWN TOOLS LIMITED

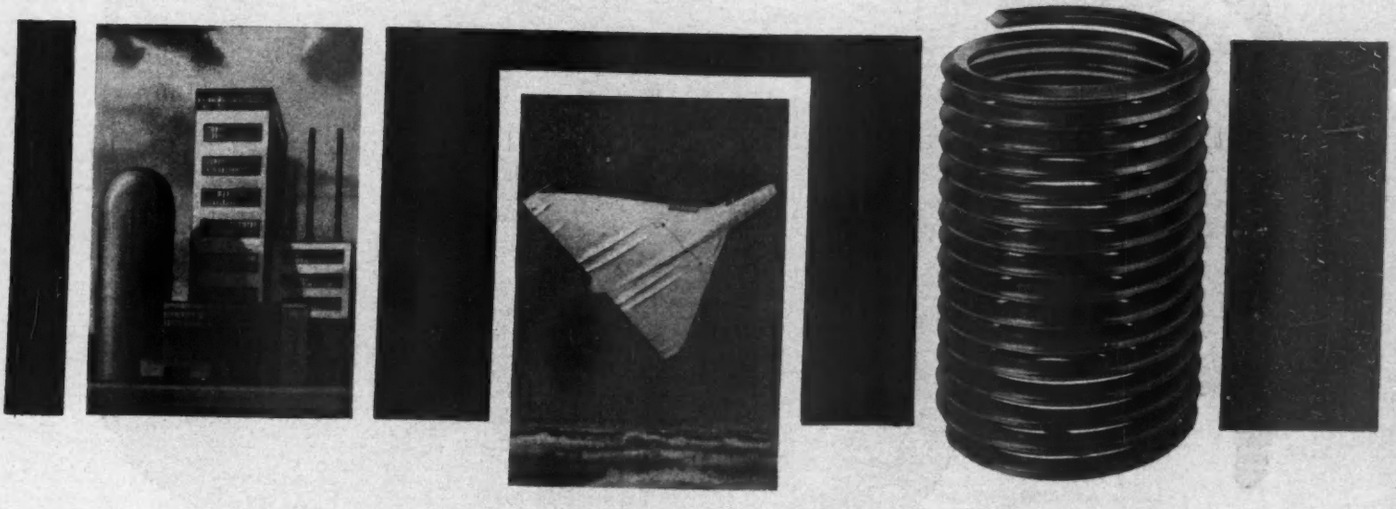
SPEEDICUT WORKS · CARLISLE ST. EAST · SHEFFIELD

the embodiment of this scientific age

Forward-looking engineers are embodying Heli-Coil Screw Th read Inserts in their designs because competition demands that they use only today's most advanced and successful techniques.
The Heli-Coil method of screw thread engineering can improve products in almost an infinity of ways . . . and at the same time make dramatic cuts in time and labour costs.
It is ideal for automation, the operation is simplicity itself, just drill, tap and install.
The Heli-Coil Insert provides a conventional thread with higher loading strengths and greater resistance to wear and stresses—it literally *armours* the thread.
The assembly obtained is anti-vibration because the Heli-Coil Insert allows pre-stressing. Weight and space are saved and the serviceability and appearance of the product enhanced.
The importance of Heli-Coil Inserts to the modern designer is an irrefutable fact. Why not have all the information in front of you—data is freely available.
Ask for Sales Leaflet APC 48/E.10.



HELI-COIL*
SCREW THREAD INSERTS



Your newest design . . . is it quite up to date?

*HELI-COIL is a registered trade mark

Write for more data on HELI-COIL inserts to **ARMSTRONG PATENTS CO., LTD., EASTGATE, BEVERLEY, YORKSHIRE**
Tel: Beverley 87212 (6 lines)

AND AT MELBOURNE, AUSTRALIA. MONTREAL AND TORONTO, CANADA.

D

Coal
BOWATERS
BOWATERS
BRITISH NEWSPRINT

keeps **Bowaters** in the news

THE MEN AT BOWATERS who run their international organisation producing paper, board and packaging of all kinds have a precise knowledge of all that goes to make their top quality products. That is why they chose coal to run the powerhouses that begin the process of paper-making at their great mills in the United Kingdom.

They chose coal because coal, mechanically stoked, provides the maximum heat at lowest cost. Furthermore, modern coal burning equipment is smokeless, and our coalfields can produce—for generations to come—*all* the coal that British industry will need.

The next time you are working out your fuel problems, remember Bowaters. For their pulp and paper mills in Kent and Cheshire they chose coal—one of the factors that point to a buoyant future at Bowaters. The same decision made by you may well begin a success story that could make headline news—on Bowaters' newsprint.

PROGRESSIVE INDUSTRY IS GOING FORWARD ON

COAL

POLICY INTO PRACTICE AT BOWATERS' KEMSLEY POWER PLANT

Mr. L. A. Robey, Deputy Power Engineer, comments:

"For many years we have operated our old boilers on coal and they have given long and satisfactory service.

The new pulverised fuel boiler which is designed for a continuous evaporation of 450,000 lbs/hr. at a pressure of 1,550 p.s.i.g. and a final steam temperature of 925°F. has steamed on coal from its commissioning date. The test efficiency obtained at full load was over 88% and this has been maintained consistently over long periods of operation with very high availability. The boiler stays very clean and with nominal maintenance excellent combustion conditions are maintained. The remote control is very flexible and meets the changing process demand without difficulty. Grit arresters collect the dust and discharge it automatically for disposal with the minimum amount of trouble.

The quality of fuels received has always been consistent and we have never failed to maintain the large stock piles which are required for the plant.

Bowaters' chose coal many years ago for their main fuel requirements at Kemsley—and still do."

Here are the details of the Bowater Kemsley boiler installation

Boilers:	10 water-tube
Method of firing:	Chain grate stokers and pulverised fuel
Boiler efficiency:	80% old boilers, 88% new boilers
Maximum steam rating:	940,000 lbs. per hour
Maximum steam pressure:	1,500lbs.persq.inch
Maximum steam temperature:	915°F.
Annual fuel consumption:	320,000 tons of coal (*Kemsley alone*)

HERE'S A JOB BEING POLISHED OFF-

BUT FAST!

You are out of date if you are not acquainted with the latest CP Equipment

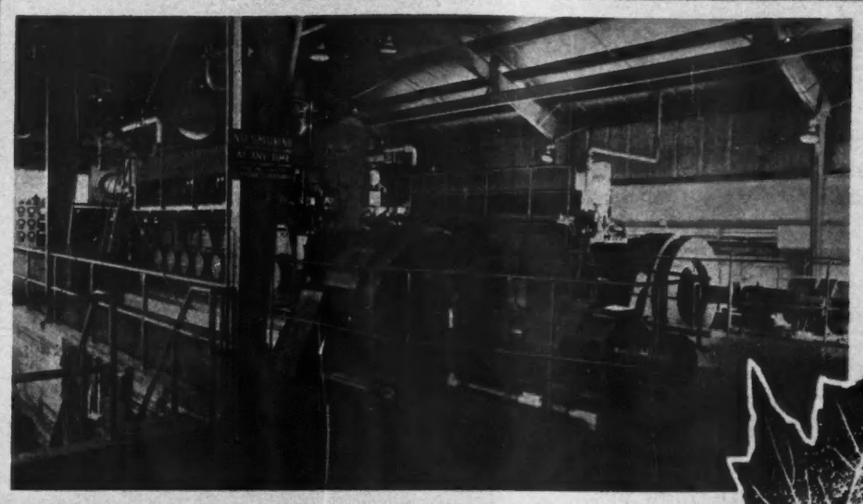
Ample power and a constant polishing speed increases operator output with far less effort than is possible with conventional tools. Increased production of up to 50% each shift is commonplace. Because Hicycle tools do the work; they require the minimum of physical effort.
There is virtually no speed drop under load and faster work is the result, with a better and constant finish.

Ask for a catalogue describing the wide range of Hicycle production tools—including angle grinders with cut-off wheels.

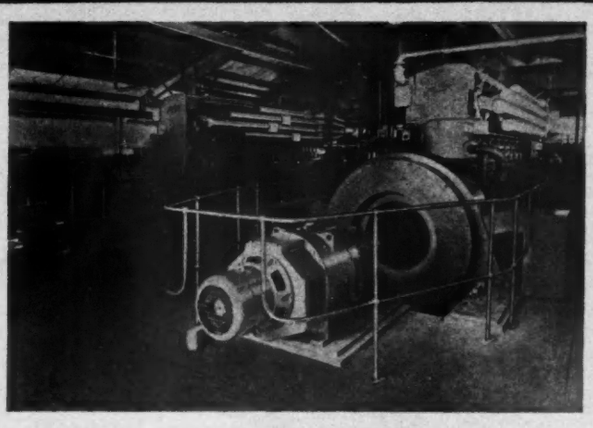
Hicycle
electric production tools by
CONSOLIDATED PNEUMATIC

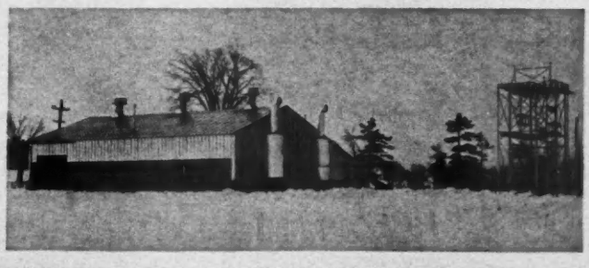
HICYCLE POLISHING *IS VERY FAST*

CONSOLIDATED PNEUMATIC TOOL COMPANY LIMITED · DAWES ROAD · LONDON · S.W.6
CP/221E



Mirrlees ....





FIRST AGAIN

with a turbo-charged dual fuel engined installation operating on natural gas in EASTERN CANADA

The Gananoque Electric Light and Power Company Limited, Ontario, have commissioned a new Power Station to meet the increasing demands of the Township. The Generating Plant of the Station which is shown above consists of two — Mirrlees KSP 8 Dual Fuel Engines direct coupled to Brush Alternators each having a continuous rating of 1360 kW 450 r.p.m.

The Mirrlees KSP and KVSP Dual Fuel Range comprises 3, 5, 6, 7 and 8 cylinder engines in line and 12 and 16 cylinder engines in vee form developing powers up to 3850 b.h.p. continuously at 450 r.p.m.

Our Overseas Associated Company in this territory is Orenda Industrial Limited, Rexdale, Canada.

Mirrlees engines

MIRRLEES, BICKERTON & DAY LIMITED

HAZEL GROVE · STOCKPORT · CHESHIRE

Tel: Stepping Hill 1000 *(15 lines)* *Grams:* Mirrlees, Telex, Manchester

IE 29

A member of the Hawker Siddeley Group

Time and time again

TIME PAST

Vokes Genspring hangers were introduced to provide constant support for high temperature pipework over a wide range of vertical movement. One of the applications for which they were specified was the support of pipework at the then revolutionary nuclear power stations at Calder Hall and Chapel Cross.

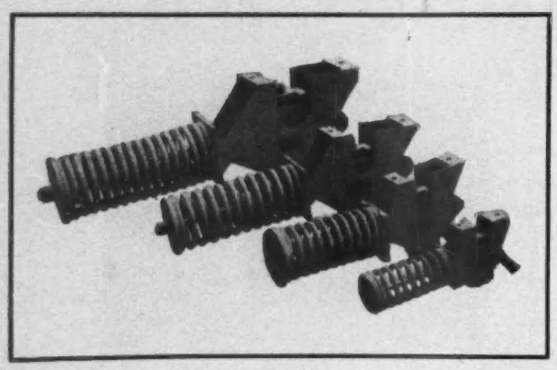
TIME PRESENT

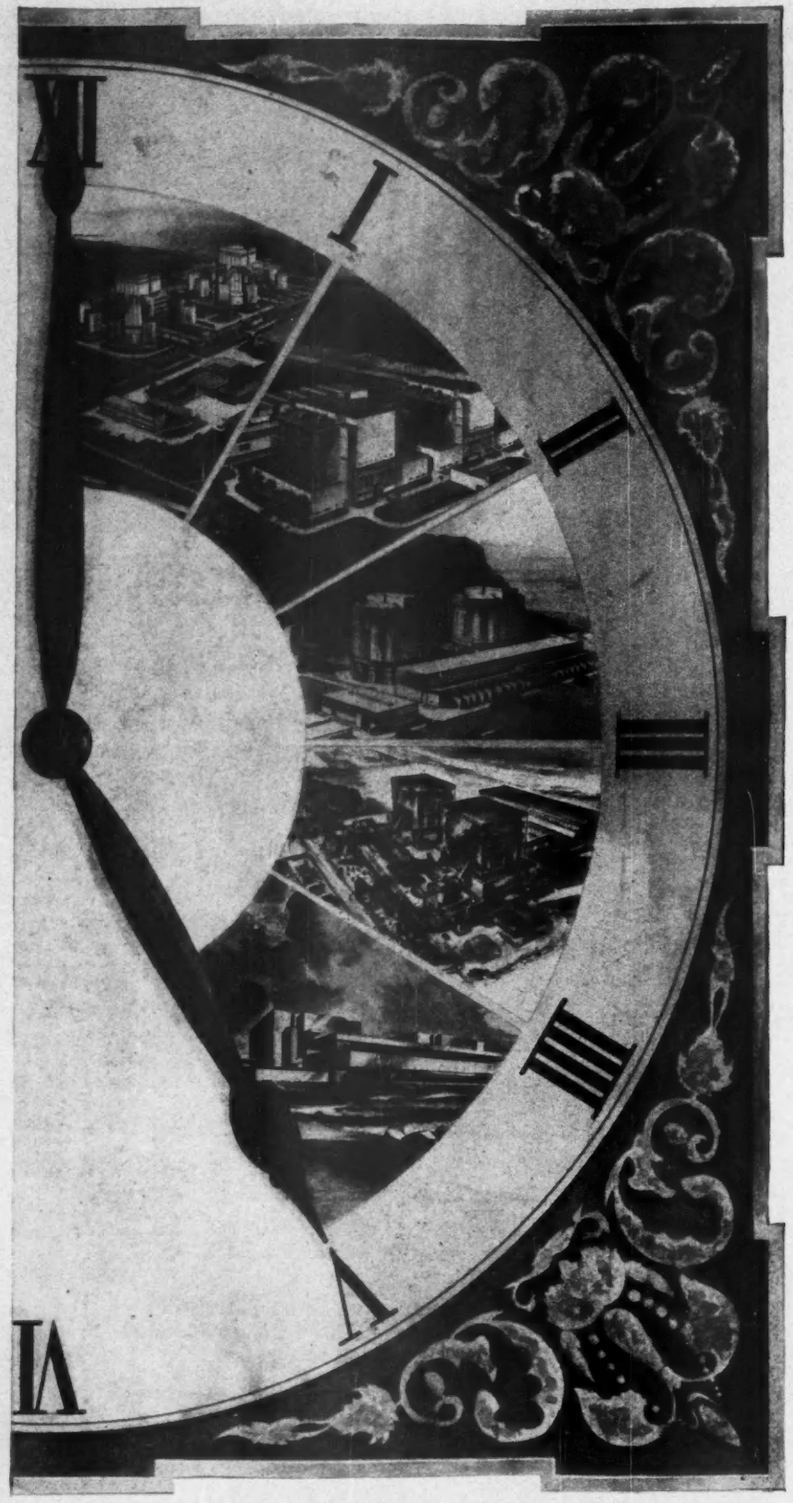
Such was their success that we are now privileged to supply suspension equipment to the five members of the Nuclear Consortia for the five latest Nuclear Power Stations. A new Genspring capable of supporting 97,800 lb. with a 12" vertical travel has been built mainly for use in Nuclear Power applications.

TIME FUTURE

Vokes Genspring have thus built up a unique fund of specialised knowledge which will prove invaluable in overcoming new pipe support problems which the power stations of the future will almost certainly present.

Illustrated below are the M1 to M4 Constant Supports covering loads from 315 lb. to 22,500 lb. and travels from 1.5" to 12". The latest addition to the range is Type M7 for loads up to 97,800 lb.





The illustrations above are artists' impressions of the Nuclear Power Stations at Berkeley (A.E.I.—John Thompson Nuclear Energy Co. Ltd.); Bradwell (The Nuclear Power Plant Company Ltd.); Hunterston (G.E.C.–Simon-Carves Group); Hinkley Point (English Electric, Babcock & Wilcox, Taylor Woodrow Atomic Power Group) and Trawsfynydd (Atomic Power Constructions Ltd.)

Vokes Genspring SUSPENSION SYSTEMS

VOKES GENSPRING LIMITED · GUILDFORD · SURREY

Telephone: Guildford 62861 (6 lines) Telex: 8–535 Vokesacess, Guildford. Telegrams & Cables: Vokesacess, Guildford, Telex

A member of the VOKES Group

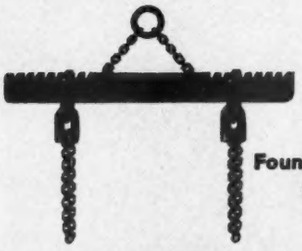
VG47

Lifting Equipment...

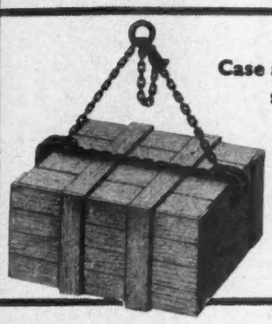
Slings and Chains of all types, for all purposes

British Standard and special shackles

Hooks of all types including British Standard Range

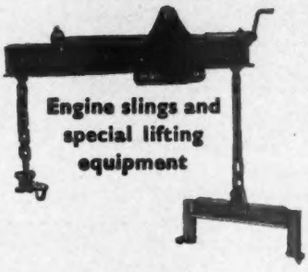


Foundry Lifting Beams



Case and Barrel slings

Boiler clamps in a range of sizes



Engine slings and special lifting equipment

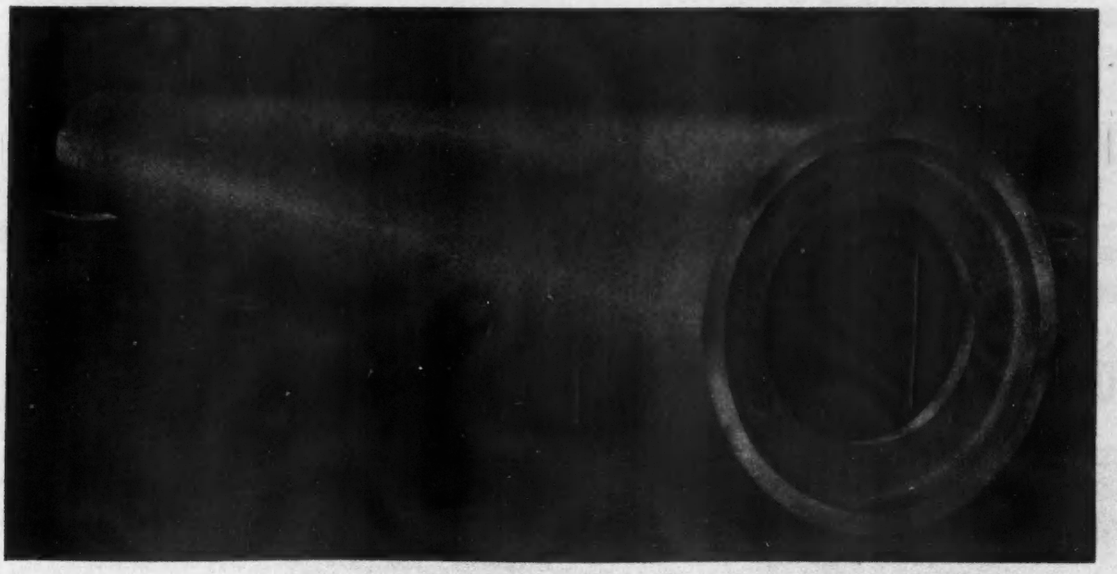
Chain & Forging Manufacturers

RICHARD GREEN LTD

P.O. Box No. 8, CRADLEY HEATH, STAFFS, ENGLAND Telephone: Cradley Heath 66061

FABRICATED CYLINDERS, CYLINDER LINERS, WINDING DRUMS AND CRANE BARRELS

BY CHARLES McNEIL LTD GLASGOW



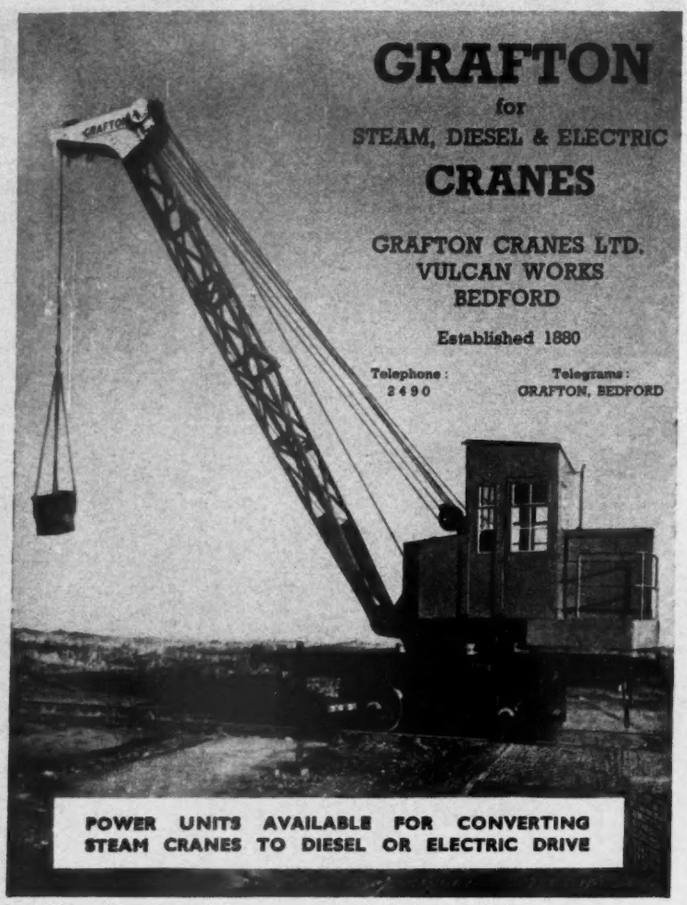
A WINDING DRUM 30FT. LONG × 2″ THICK

Enquiries to

CHARLES McNEIL LTD., 570 SCOTLAND STREET, GLASGOW, S.1

. . . and everything is arranged with Begg, Cousland—
where wire is woven in any mesh,
any metal for any purpose—as perfect as a century
of experience can make it.

SPRINGFIELD WIRE WORKS, GLASGOW, S.E



COMPRESSORS

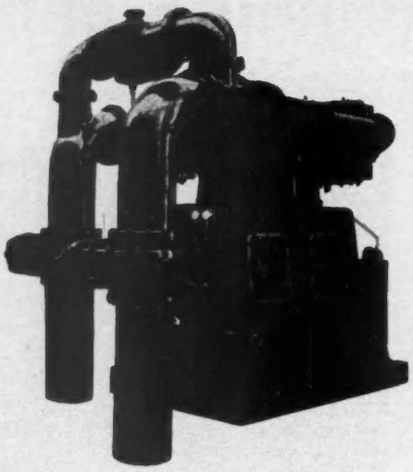
EXHAUSTERS

BOOSTERS

BLOWERS

These Gas Compressors, capacity 400,000 cu. ft. per hour at 15 lb/sq. inch, are installed at Etruria, Stoke-on-Trent.

Photograph by courtesy of West Midlands Gas Board.



Better built by

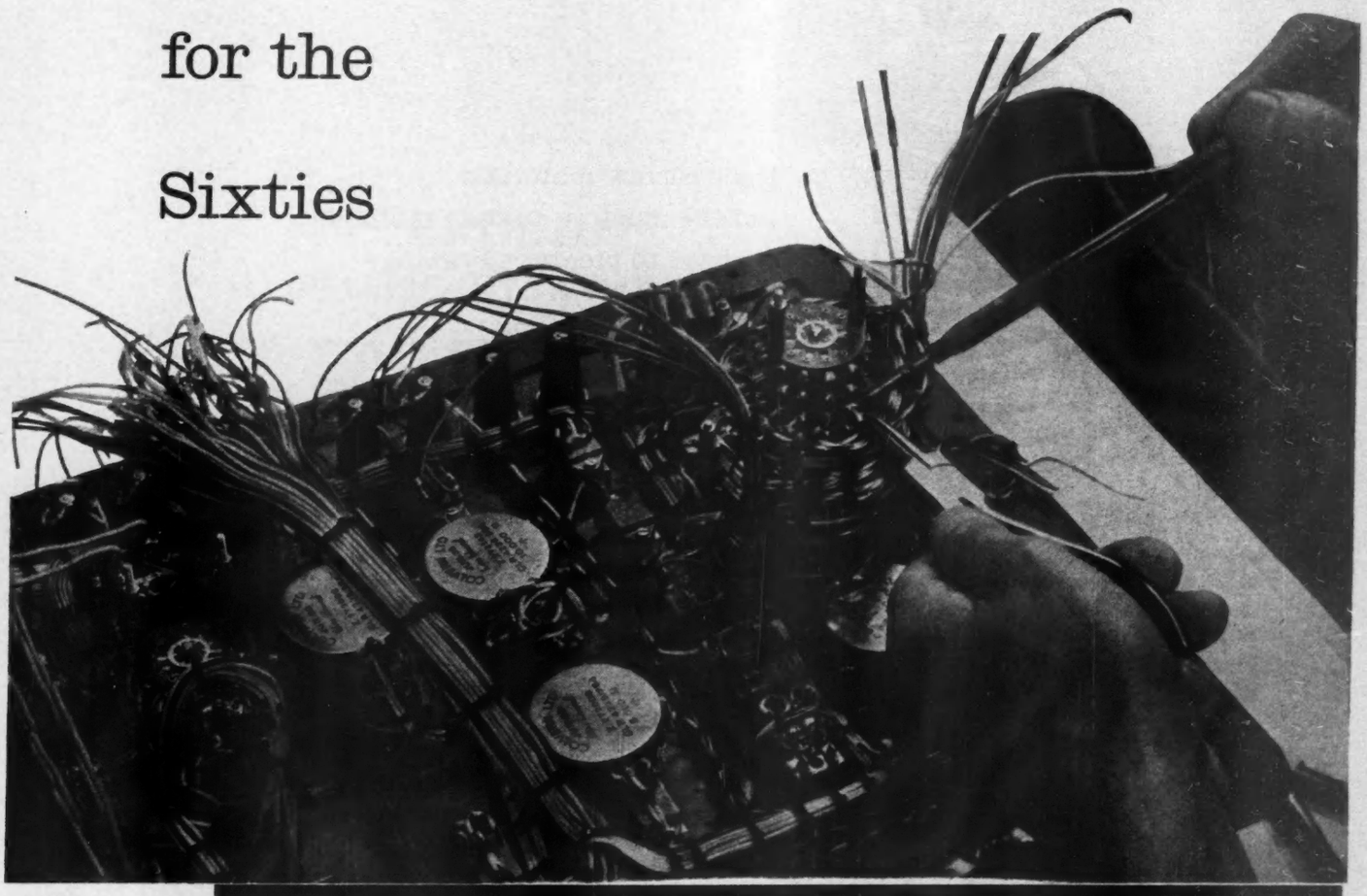
WALLER

Problems involving the transmission of air or gas—over long or short distances—at high or low pressures—in large or small quantities—can best be solved by applying more than a century's specialised knowledge and experience such as ours.

Compressors	Single or multi stage reciprocating types: pressures up to 5,000 p.s.i.
Exhausters	Roots positive type up to 15" H.G. Vacuum.
Blowers	Roots positive type: capacities up to 1.4 million cu. ft. hour: pressures up to 12 p.s.i.
Boosters	High or low pressures; positive or fan types.

GEORGE WALLER & SON LTD • PHOENIX IRON WORKS • STROUD • GLOS *Telephone: Brimscombe 2301-2*

"Knitting" for the Sixties



Data amplifiers
Automatic typewriter system
Pressure & Load transducers
Torque Measurement
Electronic Design Service
Counter Timers

It takes a brilliant mind and an orderly one to design and develop new installations and electronic techniques appropriate to the problems of the 60's. The skilful manufacture to these designs by the craftsmen, using every type of aid, is equally important. Based on the experience of the Black Knight Research Vehicle Programme and a wide range of commercial contracts, the standard of neatness and finish, essential to long trouble-free life is a particular feature of Saunders-Roe electronic apparatus. If you have an engineering problem, we may be able to offer you a solution, based upon the latest electronics engineering techniques.

SAUNDERS — ROE

A member of the Westland group of companies

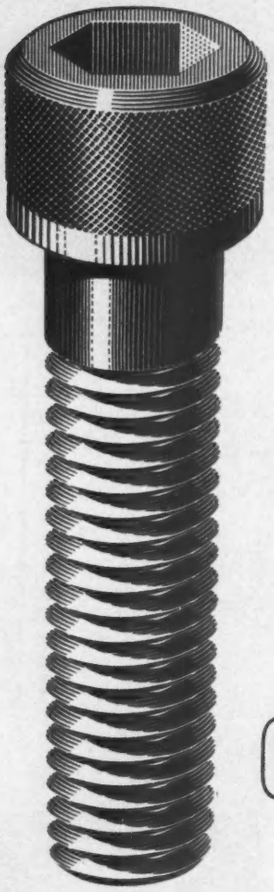
ELECTRONICS DIVISION
OSBORNE WORKS
EAST COWES ISLE OF WIGHT *Telephone :- Cowes 2211*

The best raw materials
and the most up-to-date methods
are used to greater advantage
by GKN
because of their system
of strict Quality Control,
which governs the making of

NPK SOCKET SCREWS

—in a wide variety
of sizes and threads.

This is why
NPK Socket Screws
conform to higher standards
of dimensional accuracy,
strength
and uniformity
than any other
comparable product.

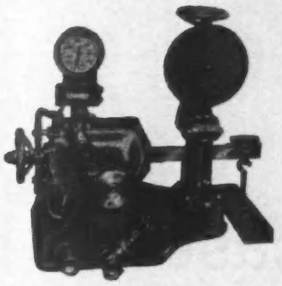


NPK Hexagon Socket Cap, Set, Countersunk and Shoulder Screws are available in a wide variety of sizes and threads. NPK WEDGLOK self-locking socket screws and NPK Hexagon Wrenches are also available.

GKN

GUEST KEEN & NETTLEFOLDS (MIDLANDS) LTD., SCREW DIVISION, BOX NO. 24, HEATH STREET, BIRMINGHAM 18. TEL: SMETHWICK 1441 TELEX 33-239

5/5/2313

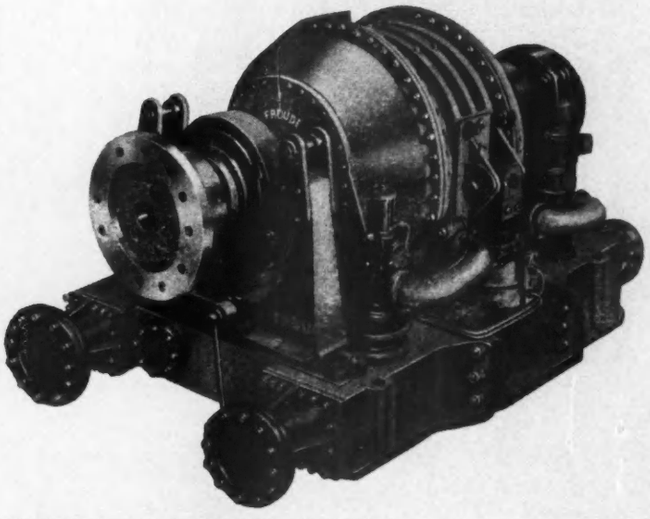


50 B.H.P. FROUDE DYNAMOMETER FOR MOTOR CYCLE ENGINES, ETC.

FROUDE

HYDRAULIC DYNAMOMETER —

known and used throughout the world wherever the testing of any class of Engine is required. Types available for the largest Marine Engine — down to Motor Cycle Engines.



60,000 B.H.P. FROUDE DYNAMOMETER FOR MARINE TURBINES ETC.

HEENAN & FROUDE LTD.
ENGINEERS
WORCESTER . ENGLAND

REPRINTS

Single copies of these articles reprinted from ' Engineering ' are available from the publisher, 36 Bedford Street, London, WC2 free of charge:

Multileaf Spring Design (courtesy of Toledo Woodhead Springs Limited).

Design for an Ocean Going Research Ship, by H. F. P. Herdman, D.Sc., National Institute of Oceanography.

Hydrostatic Drives. An interview with Mr. E. H. Bowers, Director and Chief Engineer of Dowty Hydraulic Units Limited.

Performance of Jenbach Two-Stroke Oil Engines, by Professor S. J. Davies, D.Sc.(Eng.), Ph.D., M.I.Mech.E.

Reinforcement of Branch Pieces, by Dr. J. S. Blair, D.Sc., M.I.Mech.E., Mem.A.S.M.E. (Assistant Director Research, Stewarts & Lloyds Ltd.).

Hydrostatic Tractor Drive Easy to Handle—the Lucas System Described (courtesy Chamberlain Industries Limited).

You'd raise a doubtful eyebrow...

If told that removing grease and oily deposits was a simple job, you'd think of those filthy bits of cotton waste and splodges of dirty grease and sigh and sadly shake your head. But you'd be wrong. GUNK has solved all degreasing problems and does the dirty work for you. Simply brush on GUNK—then hose or rinse off with water. As if by magic all traces of grease and oil disappear. There's nothing finer for the speedy removal of dirt, grime, grease, oil and sludge.

THE WORLD'S FINEST

DEGREASANT

Supplied ready for use in 5, 10 and 40/45-gallon drums. Send today for a free sample and prove for yourself the effectiveness of GUNK.

Manufactured by :—
BENNETT (HYDE) LTD
BOSTON MILLS, HYDE, CHESHIRE
Telephone: 1377 (3 lines)

The case for brushless is overwhelming!

No Wonder Industry is installing AEI BRUSHLESS A.C. GENERATORS

Maintenance costs cut dramatically . . . because there are *no* brushes to inspect or replace, *no* carbon brush dust to endanger insulation, *no* sliprings to be re-ground, *no* commutator to be skimmed.

Because sparking cannot occur fire risk is inherently low.

AEI brushless A.C. generators are particularly useful for standby duty and for service in situations remote from grid supplies.

Write now for leaflet to:

Despite all their advantages brushless A.C. generators cost no more than alternative equipment and are available in an extensive range from 50 kVA up to 5,000 kVA.

AEI **Associated Electrical Industries Limited**
Heavy Plant Division
RUGBY, ENGLAND

A5583

"Albion" INDUSTRIAL COUNTING INSTRUMENTS AND MEASURING MACHINES

WE MUST HAVE A COUNTER TO SUIT YOUR PARTICULAR PROBLEM, SO SEND FOR OUR CATALOGUE OR ASK FOR A TECHNICAL REPRESENTATIVE TO CALL.

TYPE 1 REVOLUTION COUNTER WITH RESET

TYPE 22 ELECTRO-MAGNETIC RESET COUNTER FOR BASE OR PANEL MOUNTING

MOST VOLTAGES

TYPE 3 REVOLUTION COUNTER WITH RESET

AGENTS REQUIRED IN MOST COUNTRIES

PATENTED IN PRINCIPAL COUNTRIES

INSTRUMENT DIVISION

B. & F. CARTER & CO. LTD.

ALBION WORKS · BOLTON 15 · ENGLAND

PHONE: BOLTON 4344 ALL LINES GRAMS: BRAIDERS BOLTON

10 ton Steam Permanent Way Crane, Metre Gauge. Duty: 10 tons at 16 ft. radius propped; 5 tons at 14 ft. radius free.

3 Motor, electrically operated Fixed Wharf Crane. Duty: 15 tons at 22 ft. radius.

T&H

CRANES

STEAM
DIESEL
DIESEL-ELECTRIC
ELECTRIC

KENT STREET

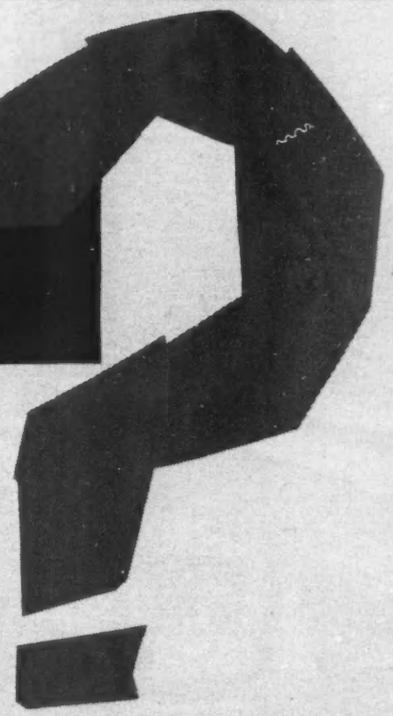
TAYLOR & HUBBARD LTD

LEICESTER

Telegraphic Address "Lifting, Leicester"

Telephone Nos.: 22575-6

ARE YOU GUILTY OF "CARELESS TORQUE"



HOW ACCURATE ARE YOUR TORQUE SPANNERS?—
without the means of checking them, you can never know.

The use of inaccurate and unreliable torque loading equipment merely represents a waste of money and effort. Yet many calibrated and dial type torque spanners have been in use for long periods and have never been checked. As a result, many operators must be working under a completely false sense of security.

CHECK YOUR TORQUE SPANNERS FREE OF COST

Without charge or obligation, we will supply ON LOAN an ACRATORK Test Rig of suitable range. Rigs are available for all loads up to 1,100 lb/ft.

Write giving range of spanners in use and sizes of drive squares to be accommodated to:—

CORY BROTHERS & COMPANY LTD, CORYS' BUILDINGS, CARDIFF

Telephone: Cardiff 31141

WORLD DISTRIBUTORS FOR

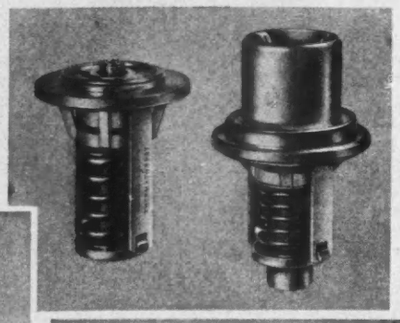
THE ACRATORK ENGINEERING COMPANY LTD

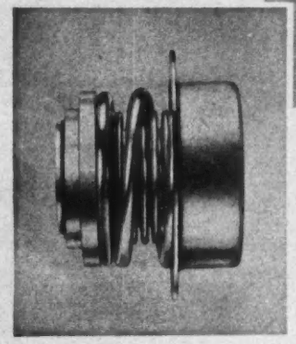
makers of precision torque loading equipment

FOR RELIABILITY AND LONG LIFE —

it must be **Teddington**

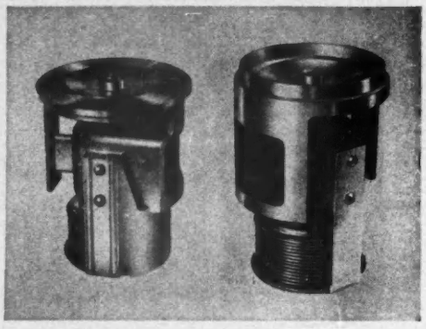
WAX-CHARGED COOLANT THERMOSTATS



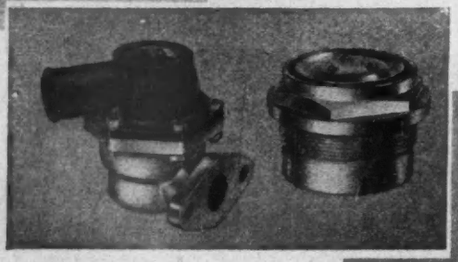


SHAFT SEALS

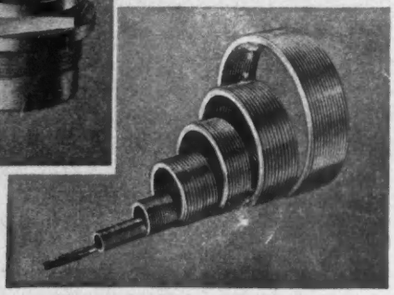
HEAVY DUTY TEMPERATURE AND PRESSURE SWITCHES



ENGINE COOLANT THERMOSTATS



PRESSURE RELIEF VALVES



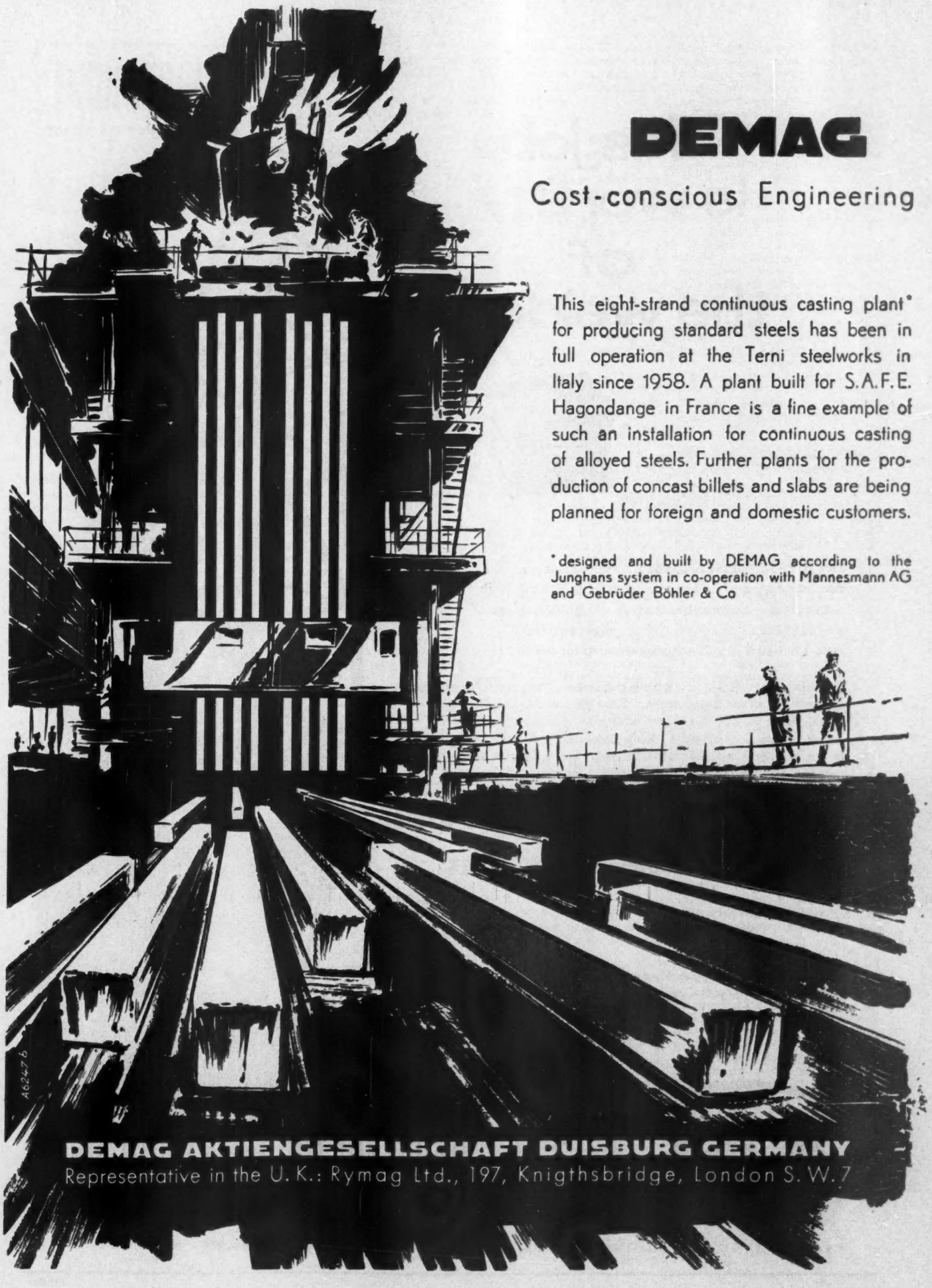
SEAMLESS METALLIC BELLOWS

Every Teddington product is backed by 30 years experience

Ask for full technical details or call our Advisory Service

P. W. BAKER & SONS (SALES) LTD., PACKLESS GLAND DIVISION

TEDDINGTON WORKS, SUNBURY-ON-THAMES, MIDDX. TEL: SUNBURY-ON-THAMES 456



DEMAG

Cost-conscious Engineering

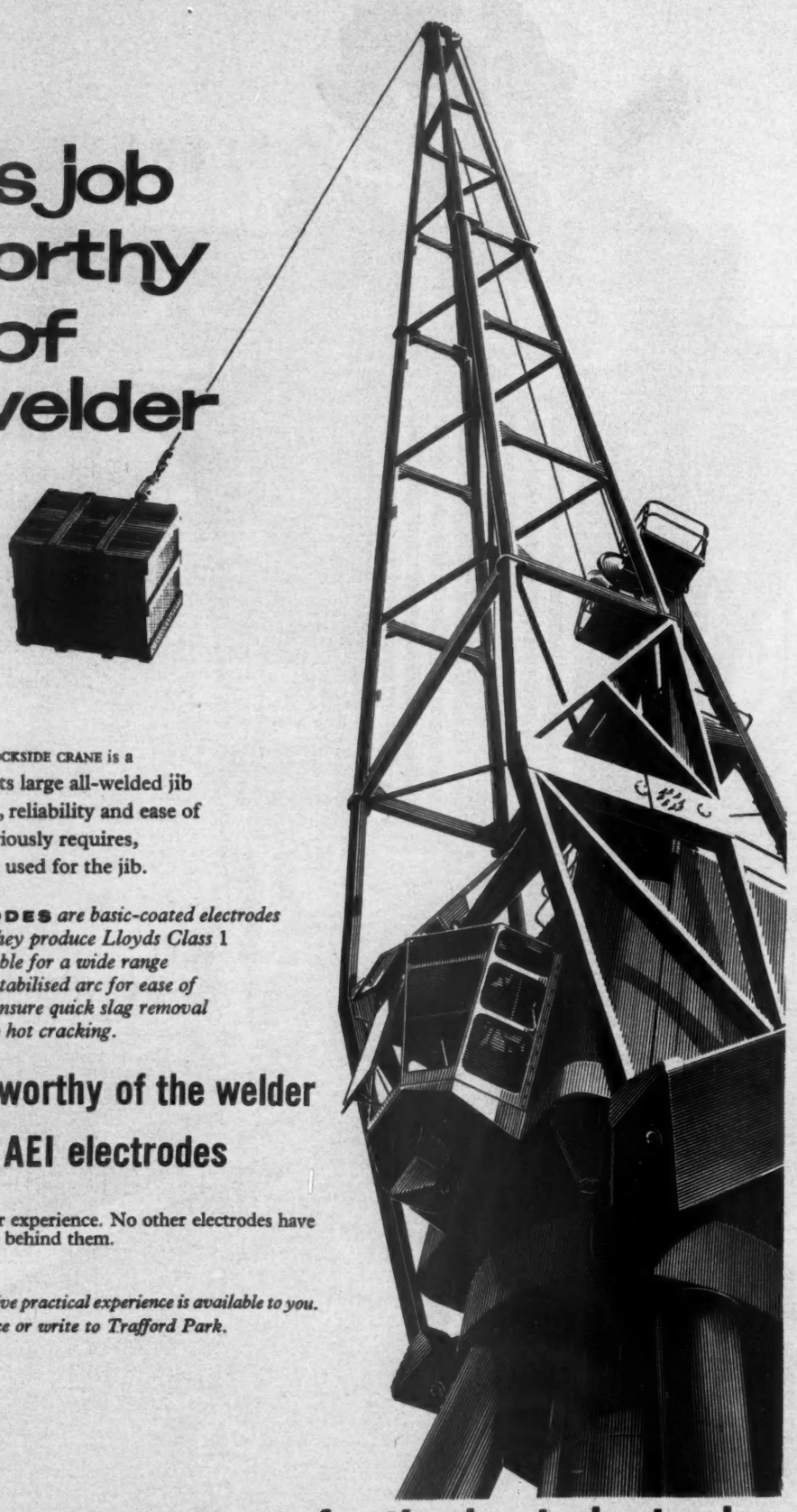
This eight-strand continuous casting plant* for producing standard steels has been in full operation at the Terni steelworks in Italy since 1958. A plant built for S.A.F.E. Hagondange in France is a fine example of such an installation for continuous casting of alloyed steels. Further plants for the production of concast billets and slabs are being planned for foreign and domestic customers.

*designed and built by DEMAG according to the Junghans system in co-operation with Mannesmann AG and Gebrüder Böhler & Co

DEMAG AKTIENGESELLSCHAFT DUISBURG GERMANY

Representative in the U.K.: Rymag Ltd., 197, Knigthsbridge, London S.W.7

This job is worthy of the welder



THIS NEW **STOTHERT AND PITT** DOCKSIDE CRANE IS A revolutionary unit in design with its large all-welded jib construction. To give the strength, reliability and ease of welding that a unit of this size obviously requires, AEI Tensivick 35V Electrodes are used for the jib.

TENSIVICK 35V ELECTRODES *are basic-coated electrodes operative in all welding positions. They produce Lloyds Class* 1 *radiographic quality welds, are suitable for a wide range of parent metals and have a highly stabilised arc for ease of a.c. operation. Tensivick electrodes ensure quick slag removal and provide exceptional resistance to hot cracking.*

You specify electrodes worthy of the welder when you choose AEI electrodes

No other electrodes are backed by wider user experience. No other electrodes have such vast research and engineering resources behind them.

OUR ADVISORY SERVICE *backed by extensive practical experience is available to you. For further details contact your local AEI office or write to Trafford Park.*

AEI —a new name for the best electrodes

HEATING AND WELDING DEPARTMENT, TRANSFORMER DIVISION
ASSOCIATED ELECTRICAL INDUSTRIES LIMITED, TRAFFORD PARK, MANCHESTER 17

L/P 005

ENGINEERING Impact

of Coal Making A Fighting Comeback

JUST as a change of General may give an Army an injection of new courage and resolution so it is possible for a business to gain new impetus from the arrival of a fresh leader.

Even so vast an undertaking as the National Coal Board. It is, of course, partly because the efforts of the staff are beginning to take effect but it is also a happy augury that even before Mr. Alfred Robens, the chairman-designate has taken over the reins at Hobart House, he is able to announce increasing coal sales.

It is a simple matter of record that before his arrival, not without controversy in itself, the talk was very much of plans and proposals. Whatever the prelude to the story the fact is that so far this year six million more tons of coal have been sold than in the equivalent weeks of 1959.

It is probably too soon to see what, if any, effect the price increase may have on this resurgence in the fortunes of the United Kingdom's only native fuel. The Board's expensive coal stocks are at last being run down and there is a possibility that by the end of the year they will be down by some five million tons.

Prolonged Struggle

There is no doubt that the fuel war will continue. There is a sufficient surplus in oil product capacities for that side of the struggle to go on making its effort indefinitely. But the successive oil conferences in Baghdad may well in time lead to a different price ratio between coal and oil. Too much should not perhaps be made of those in Scotland who would prefer to see their glens kept the way their fathers knew them, and as the tourists pay to enjoy them, but certainly they express the preference of some elements for the conventional thermal station.

For the Coal Board there is also the export market. The million tons sold overseas that Mr. Robens mentions is puny compared with the great days of Britain as a coal exporting nation. But like the six million ton increase it is the direction in which the industry is moving that is encouraging, and to be encouraged.

The Biggest Take-Over Of Them All

The £129 million offer of the Ford Motor Company of America for the 46 per cent of the British Ford Company's capital not already American owned is important to British industry far beyond the interlocked world of the car assembly plants and their suppliers.

British Ford alone among the Big Five car producers have the ability to have so far kept their Dagenham works, responsible for 27 per cent of the United Kingdom's car production, free from short time working and redundancy.

With the jaunty new form of the Anglia and a happy flair for advertising that succeeds in suggesting that even under today's conditions motoring is gay and desirable, Ford's have so far kept out of the car industry's rising troubles.

Britain has had the lion's share of United States investment in Western European countries since the Second World War. With the formation of the European Common Market and its promises of long production runs and living standards rising much faster than in Britain, there has been a good deal of prediction that United States' investment would swing increasingly away from Britain and into France, Western Germany, Italy and the Benelux states.

Two Assumptions

Now the no-nonsense business chiefs of the Ford car empire have decided in favour of a further $365 million dollar investment in the future of the British car industry. One or two assumptions would appear to have been made.

First, that the artificial division of Europe into the Common Market and Great Britain plus the relatively minor states of the European Free Trade Association will come to an end. For if it does not the future would seem to be much rosier for the German division of Ford's with its assured multi-national home market. Given a united Europe, Ford in Germany, and the company's plants on the Thames and, from 1962, on the Mersey, will have the solid advantage, along with their European rivals, especially the British Motor Corporation and Fiat, of competitive export prices based on some of the largest production runs of individual models anywhere in the world.

A second assumption must be the double barrelled one that Britain and the Commonwealth have enormous potential expansion in them as markets for British built cars. There may be no doubt about the British market but the Commonwealth countries are able to choose from which country they will buy. Australia of course has the General Motors-Holden concern producing cars suited to the local conditions and also turning more of an eye to exports both to Commonwealth countries and South-East Asia.

Vote of Confidence

The fact that so important an American business organisation as the Ford Motor Company has decided to give this substantial vote of confidence to the British motor industry creates a dilemma for the United Kingdom Government. They do not wish to discourage United States investment in Britain: to do so would be to maintain a higher degree of unspoiled control of our own affairs but at the cost of becoming a less surely expanding producer country.

At a time when our export performance is going from could-do-better to must-pull-himself-together the Government by authorising the transfer of the shares could secure a short term benefit to the tune of £129 million—and in dollars.

To the inevitable argument that as much as possible of the ownership of the British car industry should be retained in the United Kingdom it is possible to answer that major benefits from the industry are the employment of the local labour force, of home produced materials, components and services, and that the importance of the dividends on the shares falls a long way behind each of these.

of a Wind of Change Through Washington

The conclusion of the prolonged United States election battle, closer run than any expert predicted, will inescapably affect British affairs, and perhaps the United Kingdom's industries most of all.

Over the years it had become the commonplace of surveys of the United States economic scene to observe unemployment running more or less immovably around the five million mark. More recently, once the steel mills, strike effects had passed, it had become a frequently repeated figure—50 per cent of their capacity was all that was required of the country's steel industry. Over all US industry it is estimated that output is not at more than 80 per cent of capacity.

If he said nothing else concrete, Senator Kennedy proclaimed long and loud that these things were not to be as complacently accepted as in the fatalistic Eisenhower regime. In the post-election atmosphere it will not be possible for these uncomfortable facts to be ignored.

What may reasonably be expected is a vigorous attempt, as in the most memorable of the Franklin D. Roosevelt days, to get the sluggish American economy rolling forward. To shift the pattern of the nation's trade into higher gear—for two reasons. Because greater international trade with the countries of the Western world will lift the level of world trade, and it will provide the means of more aid for the developing nations, aid that may be seen as necessary to help some of them to avoid developing into Soviet influenced states.

Inevitably such a future will bring intensified competition for UK and all other exports. Having to a large degree thrust foreign cars out of their home market, Detroit's readiest way of using up more steel is to export more of its cars, compact and otherwise.

In machine tools, office machinery, agricultural machinery, a wide range of capital goods and in the consumer fields, American industries may be found starting rather late, but no less seriously for that, and they will be offering competition that will make present conditions mild by comparison.

BOAC and a British Supersonic Airliner

The British Overseas Airways Corporation now expects supersonic transports to be in use on the world air routes within "the foreseeable future." Going one stage further the Corporation believes that it should be in the forefront of this development, and preferably with British aircraft.

In their replies to the points raised by the Select Committee on Nationalised Industries (published last week by the Stationery Office, *9d*) the Corporation say: "It is the corporation's aim to collaborate as closely as possible with the British aircraft industry to this end, subject always to the limitations imposed on them by financial and economic considerations."

What BOAC are in effect saying is quite clear. Naturally enough they would like to operate their transatlantic money-spinning routes with British built supersonic aircraft when the time comes, and that time is plainly not to be arbitrarily postponed.

But they do not only carry British passengers. BOAC is totally committed to the full blast of international competition. The multi-million dollar purchases of the current American built "big-jets" underlined for the British aviation industry that BOAC had of necessity to buy the best, at almost whatever cost of prestige and subsequent amortisation.

As things stand, an early Government development contract having appeared on the scene, it is open to the regrouped British airframe manufacturers to win their way to replacing BOAC's current, or on order, long-haul aircraft. Rolls-Royce are capable of looking after themselves in the battle but for them too there are advantages in the success of a British built supersonic aircraft.

There is a long scale of years in this, and not much of what is being done can show above the surface. But the question is certainly in the URGENT category.

and Accelerating the Pace Of EFTA Development

The Conference on EFTA held in London on 7, 8 and 9 November was addressed by no fewer than four members of the Cabinet, including the Prime Minister, and there were Ministers from all member countries at the conference.

Two points came out of the conference. First that EFTA is a market of 90 million people, mostly with high living standards. Second, that the biggest gains will be in the United Kingdom market where high tariffs keep out many of the products of Swiss and Swedish engineering firms. For some types of electrical goods, machinery, machine tools and chemicals, the rest of the Seven are going to bring considerable competition into the British market. But there is no doubt there will be opportunities for more trade the other way.

The difference is that it is scattered in six small countries each of which will need a separate sales and promotion effort. The EFTA presents no soft option for British exporters. Under the Stockholm Convention we have agreed to remove tariffs on trade with the Seven by stages over ten years. A British proposal to halve this was bitterly attacked. Norwegian and Danish delegates in particular said that speeding up tariff cuts would bring ruin to their industries.

The Swedes and Swiss were all for free trade as soon as possible. So were a number of British manufacturers including the chairman of a big firm in the electrical industry.

Manufacturers involved in export trade want to get tariffs down as soon as possible. The whole object of EFTA is that British washing machines, cars and lathes should be on sale duty-free in Stockholm, or Vienna, or Berne, and that Swiss watches should be on sale here on the same terms. The Swiss in particular want to see bargaining going on in the EFTA to shift some of the bottlenecks. One suggestion was that Switzerland should reduce its tariff on cars in return for a cut in the British duty on watches. This was just one example of a selective speed-up that would really set trade moving.

Make It Yourself with Silicone Rubbers

Cold curing silicone rubbers can be mixed from a couple of bottles. They are novel, and some say they are curiosities; but the fact remains that several firms are saving a lot of money and time by using them.

AT JUST over £1 a pound there seems at first sight to be little future for cold curing silicone rubbers. But it is not good enough to dismiss them without further thought. Look, for instance, at the names of actual firms mentioned around this page: these people are using these materials in their factories—and they're not in business for fun. The fact is that there are great savings to be had in many instances where a rubber moulding is wanted in a hurry and where resort to mixing the contents of two bottles is attractive. On top of this, the materials produced after a few hours at room temperature can be taken right up to the limit for ordinary silicone rubbers (slowly the first time)—in other words up to 250° C. Subsequent to this, they can be cycled between this top limit and − 60° C with complete safety, and being virtually 100 per cent solids materials, even the original shrinkage is only around the 1 per cent mark.

If this begins to make sense, consider other properties of the materials—they are almost identical to those of heat cured silicone rubbers, in that they have excellent stick-free surfaces; and will take up very fine surface detail. These properties are just not to be found together in any other rubber—so perhaps the price will begin to seem less of a handicap.

A German firm called Wacker first developed these rubbers in 1955 and Midland Silicones sold them in the UK in the following year; since 1959 the British firm have been making their own under the name Cold-Cure Silastomer. General Electric, also in the USA, had experimental silicone rubbers way back in 1954, and ICI in this country, who share GE's silicone knowledge, modified the American formulations and set off making their own in 1959, which they call Silcoset rubbers. The French firm of Rhone-Poulenc make and sell an "unconventional" version which is one-pot and cures by contact with atmospheric moisture. Finally, Dow Corning, in the USA, who are tied up with Midland Silicones, make a wide variety of cold curing silicone rubbers including soft and one-pot types.

This may all sound very complex, but it boils down to the fact that Midland Silicones and ICI both supply the rubbers in the UK, and to make life easy, the varieties they are currently selling are white from the first firm and red from the second.

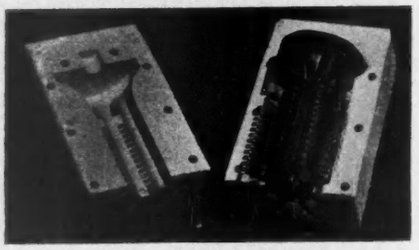
Both companies market three varieties with different consistencies which can be called fluid, viscous and putty-like. When left at room temperature until set, which takes anything (as you specify) from 4 hours to 24, the tensile strength will be around the 450 lb per sq. in mark, with an elongation at break between 120 and 240 per cent (the higher figure being obtained with the putty grade). These properties are reasonable and change very little after heating to 250° C, but there are disappointingly low tear strengths in the 2 to 10 lb range which call for fabric reinforcement such as used by Pytram (top right) if the rubber is going to be flexed very much.

Note that adhesion up to the strength of the cured rubbers is easily obtained with suitable primers, but normally the anti-stick properties —which are even superior to those of heat cured silicones—will prevent adhesion to anything except themselves, which they do readily. Arising from this, their one last attractive property is that the material can be repaired by cutting out the bad patch and pouring more in.

Midland Silicones Limited, 68 Knightsbridge, London, SW1.

Imperial Chemical Industries Limited, Millbank, London, SW1.

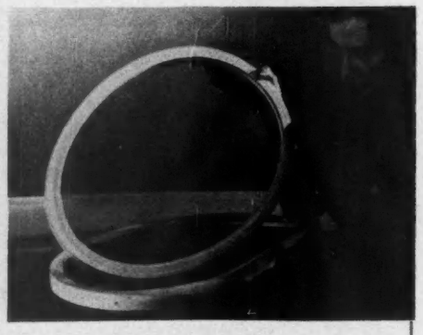
***Moulds for Plastics.**—Pytram make epoxy mouldings for display purposes by casting into cold cure silicone rubber moulds. These are made from a master by laying up Midland Silicones' rubber with scrim cloth—put in to give improved tear strength and double the life. They use silicone rubber wherever mouldings have reentrant angles, and where a plaster mould would have to be split into about six components or more. Pytram reckon on lives of several hundred castings for the simpler shapes.*



***Detail.**—This shows the detail which can be expected. Midland Silicones' product is here used by Hivolt for making moulds for casting epoxy resin coil formers. ICI have made a replica of a long playing record by this process which gave good reproduction when played.*

***Electrical Sealant.**—Backer Electric seal their washing machine heating elements with cold curing rubber. Rejection of elements because of their low insulation values has virtually ceased. Potting and encapsulation are other probable outlets, but seem limited to where impact absorption or easy stripping are needed.*

***Resists Dip-Soldering.**—Among the items produced by Kolster Brandes are printed radio circuits, and during the process of manufacture it is necessary to dip-solder the circuits at 240° C. Cast iron or steel covers coated with Midland Silicones' rubber are clipped over control spindles and can be used over and over again.*



***Aircraft Window Seals.**—A. V. Roe were faced with an urgent need to make window seals for the prototype Avro 748 airliner, and decided to make them in Midland Silicones' cold curing rubber. This time the mould was made from reinforced plastic laminate. The 1½ lb silicone rubber castings were made to a 6 hour cycle.*

Acceptance of Vitreous Enamelled Aluminium

The company of Ernest Stevens is no more. And this name, you will remember, was the one behind Judgelite vitreous enamelled products. Now the Architectural Panelling Division is formed into a separate company called the Judgelite Company.

In this country practical applications of vitreous enamelled aluminium are starting to appear (as a lightweight alternative to vitreous enamelled steel, where this finish is desired). The main use is in architecture, internal as well as external; for curtain wall infill panels, partition panels, wall tiles and decorative trim. It is, however, also very suitable for other uses, such as road and advertising signs and domestic appliances. Vitreous enamelled aluminium hollowware is already on the market.

Thus, with many uses ahead and some already established, the new company of Judgelite is being extended to cope with a full order book. During the last two years, they say, their panels have been selected for well over a hundred building projects.

Buildings where Judgelite panels have been specified

Project	Contractors or Sub-contractors	Architects
Dolphin Court, Hove	Hotchkiss Engineers, Eastbourne	Morgan and Carn
Bromsgrove Junior School	Spicers	Cassidy, Farringand Dennis
Snakpak Food Products	John Williams of Cardiff	—
Gold and Silversmiths Piccadilly	Frederick Sage and Company	—
Ferro Enamels Offices, Wombourn	—	Ferro Corporation
Open Air Theatre, Bishops Park	Roberts Adlard & Co.	—
Macclesfield Prefabricated Station	Tinker and Young	British Railways Regional Architect
Glasgow University	Henry Hope and Sons	

There are two main firms in this business of making vitreous enamelled panels for architectural use—the one we've been talking about, but also Matthew Swain of Manchester, who have done quite a deal of business in aluminium. Backing them up, the Vitreous Enamel Development Council has released a tentative commercial specification for these panels. So far, in the four weeks since it has been generally published, nobody has come up with any points of disagreement and the Council are hoping that it will form the basis for a new British Standard. The original standard, BS 1344: 1947, "Methods of Testing Vitreous Enamel Finishes" is in course of revision and will have to be extended or a new one issued to cover the aluminium product.

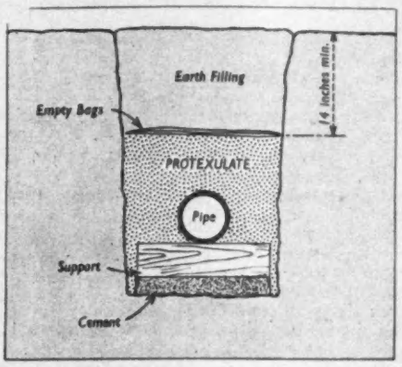
Judgelite Co. Limited, Cradley Heath, Staffs.
Matthew Swain Limited, Newton Heath, Manchester, 10.
Vitreous Enamel Development Council, 28 Welbeck Street, London, W1.

Hot Pipe Insulation

There are underground movements afoot. "The cost of ducting and lagging overall, inclusive of labour, etc., can run to as much as £4 to £6 per foot run, whereas at a conservative estimate about 30 per cent saving in cost can be effected with Protexulate and this does not take into account the fact that the whole installation can be completed in a fraction of the time." Thus writes the manager of Croxton and Garry, who have started marketing this silicone treated magnesium carbonate powder with full instructions on how to actually put it to work. It is meant for thermal insulation of underground pipes.

As shown in the illustrations, use of the material can obviate concrete ducts and lagging with asbestos or fibre glass. Bags are placed on top of the mineral insulation so that the backfill of earth does not mingle with the powder while it packs down to its density of about 60 lb per cu. ft. But what about settlement and earthworm disturbance? "In our opinion, there is no reason why earthworms or any other worms should burrow into an inert mineral powder to any depth, as it is not palatable to them. However, should this occur . . . the grooves would be filled again by the material itself."

Croxton and Garry are convinced that the



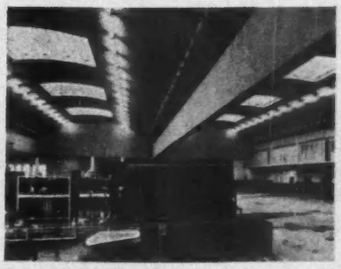
water repellent treatment will not wear off even if the ground is saturated with water. But who else has been convinced of this? "Since this material was introduced at the beginning of the year we have carried out a number of trial installations for the various Ministries, particularly for

the Air Ministry and War Office, who have specified it on two of their tenders. Hospitals are also most interested. You can well imagine that any factory or building where it is necessary to run a length of heating pipes from existing boilers to new buildings and out-houses, can be done quite satisfactorily in a very short time at a low cost."

Croxton and Garry Limited, 16-18 High Street, Kingston-on-Thames, Surrey.

Fight Condensation With Vermiculite-Cement

Vermiculite renderings are well known for their properties of adhesion, fire resistance, thermal insulation and prevention of condensation and subsequent corrosion or damage. In the new bottling hall of the Newcastle Breweries, a sprayed rendering of vermiculite-cement by Pyrok has been used to avoid acute condensation.



In this instance it was essential to have a clear floor area in the bottling hall itself of 150 ft by 200 ft, to give freedom in planning and layout of the plant. To achieve this, a concrete shell roof was adopted consisting of four bays each 150 ft by 50 ft span. To avoid condensation, the architect, Mr. C. P. Wakefield-Brand, made sure that there was adequate ventilation and extraction of air, with a warm current of air over the ceiling area; that the roof was insulated externally; and that the underside of the vaulted roof was treated—in this instance with Pyrok.

To avoid fungicidal growths, a special anti-fungicidal solution was incorporated in the mix, and after 18 months this has proved to be entirely satisfactory. Under extreme conditions of humidity, no condensation has resulted.

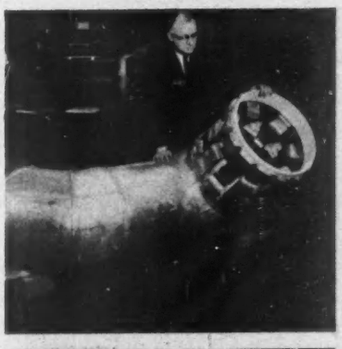
Pyrok Contracts Limited, Pool Lane, Langley, Birmingham.

Aluminium Busbars Take 10,000 Amps

Aluminium Development Association and other people who aim at presenting the rosiest picture for the future of this light metal might care to add a little more grist to their mill. The Delta Star Electric Division of H. K. Porter Company in the USA feel that "aluminium is the only possible material for capacities of 10,000 amps and over."

In practising what they preach they have recently fabricated what are believed to be the largest electrical busbars in the world—in aluminium. They will carry electrical energy from a turbine generator into the switchyard of a power plant. With $\frac{3}{8}$ in thick walls and diameters of 19 and 20·5 in, they are rated at currents of 10,000 to 11,500 amps for operation at voltages of 12·6 to 16·5 kV.

The 19 in tube is an extrusion, supplied by Alcoa. From electrical conductor grade billets, the tube is produced on the company's 14,000 ton extrusion press. The 20·5 in tube is roll or brake formed by Delta Star from plate, joined by



argon gas MIG welding. A total of over 2,300 ft of busbar has been fabricated by Delta Star for three major utility installations.

With the exception of insulating supports, virtually the entire busbar assemblies are aluminium. Surrounding the busbar is a 42 in diameter isolated phase housing of continuous roll-formed and seam-welded 1100 alloy aluminium sheet of $\frac{1}{8}$ to $\frac{1}{4}$ in thickness.

These busbars are of telescoping design, said to be a unique Delta development. Also, flexible leads for the joints are made of 40 aluminium sheet laminations which are welded to plate at either end and flex during expansion.

Aluminium Company of America, Pittsburgh 19, Pa, USA.

Plain Words

By Capricorn

ANYONE who has tried to enlist a good after-dinner speaker will sympathise with the secretary of the Birmingham University Mechanical Engineering Society, who has advertised thus: "Watt Society requires famous non-engineer to give very informal speech at Annual Dinner, Tuesday, 28th February, 1961."

In all such cases of finding suitable speakers, the difficulty is that one knows so few people who would be suitable. Even if the choice is being made by a committee of, say, six, you are lucky if between the lot of you a reasonably wide selection can be mustered. A few television personalities and a few politicians spring to everyone's mind—which inevitably means that those gentlemen receive so many invitations there is little chance of securing them. We must therefore rule out Mr. Gilbert Harding, Mr. Richard Dimbleby and Mr. Cliff Michelmore (who, in any case, was once an engineer). The politicians must also be ruled out in this instance since I cannot imagine them being prepared to give a "very informal speech."

The important point is to aim high, and only lower your sights when you are compelled to. I do not know on what basis the Royal Family accept invitations, but certainly the Duke of Edinburgh has earned an enviable reputation for giving informal speeches. Nor does his informality prevent him from putting over some good sense and acceptable advice. His speech at the luncheon of the Gauge and Tool Makers' Association last week left his audience with a conviction that he is remarkably well informed on trends in industry.

The wording of the secretary's advertisement suggests that the members of the Birmingham University Mechanical Engineering Society are prepared for a little ragging, a little gentle leg-pull from their famous non-engineer. What a temptation to a non-engineer! To whom should that opportunity be given? Perhaps it is a rather quixotic choice, but I would like the invitation to go to Sir Charles Wheeler, sculptor and Past-President of the Royal Academy. So many of his works have been in bronze, or allied to architecture, that I would hope he could open our eyes to a lost link between two major plastic arts—sculpture and engineering—the two at opposite ends of the aesthetic-utility scale of values.

It is only necessary to look at illustrations of 19th century steam engines, with their classical columns and plinths, to realise that there is immense freedom and scope in the design of the outward form of engineering products, and to realise, also, that we tend to conform very closely to the current idiom, seldom showing the boldness to see new possibilities of form and appearance. Engineers and architects tell each other what they should try to aim at; so do architects and sculptors. Why not sculptors and engineers? It might release new imaginative energies.

Letters to the Editor

Engineers on British Railways

SIR, Mr. Austen Albu goes much too far in his article "Modernisation Needs Modern Railwaymen" (ENGNG., 4 Nov., '60, p. 604), and does British Railways and their supplying manufacturers a considerable injustice in this interpretation of the evidence placed before the Select Committee.

Of course British Railways are short of fully qualified technical staff in some parts of their business. Of course some mistakes have been made. Few large industries subjected to the searchlight of a public inquiry would be able to claim perfection in such matters, in a country admittedly short of engineers and scientists. But these shortages and mistakes must not be exaggerated.

What Mr. Albu does not even mention is the quite remarkable technical success railway engineers have achieved, notwithstanding difficulties, in the very short space of five years, in the introduction of diesel traction throughout Britain, and in the development of alternating-current electrification and its very successful application to important lines in the London and Glasgow areas, and on the London Midland Region main line. In conjunction with this, civil and signal engineering work has been carried out on a vast scale, on the busiest railway system in the world. And yet, five years ago, British Railways were doing little more than maintain their structures and equipment, and modernisation at the present pace was hardly contemplated.

British Railways now employ 8,000 technical staff of all kinds. Of these, 1,400 are qualified engineers, of whom over 500 are university graduates.

This staff is engaged not only on modernisation work, but also on the less spectacular but highly important job of the maintenance of track, structures, rolling stock, and other equipment. Not all of this work necessitates the highest technical qualification. There is no point in expressing the number of qualified staff as a percentage of the total staff of British Railways, as Mr. Albu does. The majority of railwaymen are engaged on traffic duties, and have nothing to do with engineering.

It is not the railways' job to undertake the specialised design of diesel engines or electrical gear, any more than it is the job of the bus companies to design bus engines, or of the British Overseas Airways Corporation to design jet engines. It is the job of British Railways' engineers to specify what they want and see that they get it by the most economical methods, and to carry out detailed design only where they undertake the manufacture or construction themselves.

The Commission do not deny their need to recruit more graduates and to improve the higher education and technical qualifications of their younger staff. They recognise the need for men with scientific training of a high standard to direct and apply the fruits of research to their engineering endeavours. But it takes time to train young engineers to take full responsibility for work upon which the safety of the travelling public depends.

The British Transport Commission are confident that their engineers, now amassing experience of new techniques at a rapid rate, will tackle the jobs that lie ahead with growing confidence and expedition, and that this alone will go far to offset the shortage which, in common with industry generally, the Commission have suffered in the last few years.

Yours faithfully,
JOHN RATTER,
C.B.E., B.SC., M.I.C.E.

Member, British Transport Commission,
London, NW1.
11 November, 1960.

Railway Expenditure

SIR, With reference to your recent Impact note (ENGNG., 4 Nov. '60, p. 597), I feel I must comment on your criticisms of the Government's intention to reduce expenditure on the railways in 1961.

I suggest that your remarks do not take into account changes in the transport situation. For example, you argue that, because of the economic success before the war of the electrification of the Southern Railway's suburban services, the London Midland main-lines should also be electrified. Yet it is admitted by the British Transport Commission that the electrified suburban services are run at a loss. Furthermore, electrification of these services was necessitated by traffic carrying capacity requirements, whereas the London Midland main-lines have excess capacity.

Modernisation is not the panacea for railway ills that it is supposed to be. In fact, since modernisation began, the economic plight of the railways has worsened. In the year before the commencement of modernisation, the railways had an operating surplus of £16·4 million. In 1959, this was replaced by an operating deficit of £42 million. The true reason for the railway deficits is that road transport is now economically superior for all but high density long distance transport operations. Hence, broadly speaking, only main-line railway routes are profitable.

Clearly, the economic success of the railway system depends on closing down its unprofitable parts, but railway routes can only be closed if roads of sufficient quality are built to replace them. (In some urban areas this may mean converting the railway routes themselves into roads). Hence, the economic viability of the railways is very much dependent on the road-building programme.

Owing to the tax-absorbing nature of defence and the social services, only about £250 million is available each year for transport improvement grants. In recent years, the majority of this money has been spent on the railways. It is possible, however, that the Government has now realised that to allocate more of this money to road building will benefit not only road users but also the railways by enabling them to close down their unprofitable routes more rapidly.

Yours faithfully,
M. J. KEEDWELL.

New Malden.
10 November, 1960.

Spiral Conduit Ducts

SIR, We think that we may be able to contribute some useful information as a result of your special article on "Plans and Demands in Air Conditioning" (ENGNG., 4 Nov. '60, p. 610), and we can tell you of a development which has been asked for by Associated Electrical Industries Limited for a cheaper form of ducting.

We have pioneered the introduction of spiral conduit ducting in this country and are now offering to sell it for general use, through our manufacturing concern, the Carrier Construction Company Limited, Wembley. Initially, this construction of ducting was used extensively in the United States for the distribution of air at high velocities and high water gauges, and as a special feature of the Carrier "Weathermaster" system of air conditioning.

The Americans cooperated with, and adopted, the ideas of certain European engineering companies in developing the machine for manufacturing the conduit ducting, and the equipment now used by the Carrier Construction Company incorporates the latest features of the machines so developed. Steel, aluminium, brass or copper strip is fed continuously to the machine which winds it spirally into a former, the edges of the strip being overlapped to make a pressure-tight seamed joint which projects as a stiffening spiral rib on the outside diameter of the duct, while leaving the inside surface free from all projections. The spiral reinforcement formed by the locked seam joint gives the conduit such

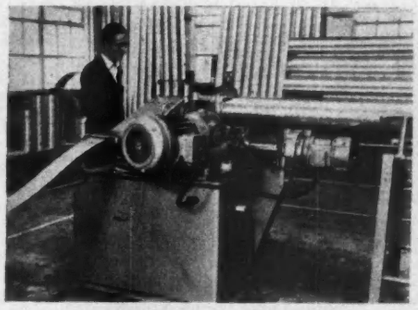


Fig. 1 Carrier winding machine in operation.

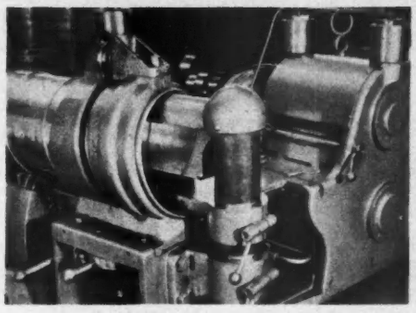


Fig. 2 The forming end of the machine.

strength that it may be made of material of approximately half the gauge of the material required for comparable conventional ducting.

A wide range of diameters can be produced by adjusting the machine and changing the former; the smallest outside diameter obtainable being 3½ in, increasing by increments of 1 in from 4 in up to 12 in outside diameter, and then by increments of 2 in up to 28 in. The maximum size is 32 in outside diameter. In the accompanying illustrations, Fig. 1 shows the Carrier winding machine in operation, with examples of the conduits produced in the background. Fig. 2 shows the forming apparatus.

For convenience of handling and transport, the standard length produced is 10 ft, but lengths of up to 20 ft can be supplied to suit special requirements. The conduit lengths are perfectly straight, the internal diameters being true and maintained to very fine limits to match up to standard connecting fittings, T's and bends, which are also manufactured by the Carrier Construction Company.

There are numerous practical advantages of this modern form of producing ducting. The reinforced strength achieved by the continuous spiral seams enables the supporting brackets to be widely spaced, with a consequent saving of cost of materials and site labour; individual lengths can be butt jointed without bolts, using sleeve fittings sealed with a special compound, and the whole forms a system which is completely airtight when tested at pressures greatly in excess of those used even in modern high-pressure ducting installations. Size for size, conduit ducting can be produced considerably cheaper than ducting made in the conventional manner. It is non-resonant, which is a most important factor considering that it is used very extensively for distributing air at high velocities in buildings where the level of noise is of extreme importance.

We have already proved to numbers of users that when a range of ducting is required urgently (for instance as a replacement after fire damage), then conduit can be produced within as many days as conventional ducting formerly took weeks. This is a very special advantage which will readily be appreciated by all contractors continually faced with the time hazard.

Yours faithfully,

J. A. E. HEARD, Sales Director.

Carrier Engineering Company Limited,
London, SW1.
7 November, 1960.

Congestion and the Traffic Engineer

SIR, I have read with interest the exchange of opinion between Commissioner Waldron and Professor Proudlove (ENGNG., 11 Nov. '60, p. 636). From a study of conditions in urban centres in this country and in the United States, two principles of vital importance for cities emerge:

1 Public transport systems must be stimulated and made as attractive and efficient as possible—even at a financial loss.

2 Urban motorways must pass through or close to the centre of large cities if full benefit is to be obtained from their presence.

If development of city centres is dictated by traffic flow alone, public transport dies. The immense efforts now being made (perhaps too late) in America to rebuild decayed or vanished city public-transport systems is evidence of their value. Any city plan which does not include facilities for mass transport of the population to, from and in the centre, is certain to be a failure.

Public transport, competing with private and commercial vehicles on the surface streets, is easily sent into a decline by traffic congestion, but traffic congestion, especially at peak hours, is effectively relieved by the "draining" effect of urban motorways. These "drains" must, however, run close to the city business district. "*An inner ring road some two or three miles from the centre*" would be quite useless in relieving central congestion. A *distributive loop* of motorway standards—sunken for preference—passing closely round each business district would, however, have an immediate and beneficial effect.

This is no "long-haired" theory! Its action can be seen in any rush period in central Los Angeles where, in the business district, the traffic is light and pedestrians move freely. The nearby freeways—out of sight in sunken channels—are carrying more than 1,500 vehicles per hour, per lane. On re-visiting Los Angeles this year, after a 30-year interval, I could see little real change in the layout of the central city streets, but traffic conditions were much easier than 30 years ago. This can be attributed to the distributive loops of the motorways—only a small proportion of the total road mileage. With the effective public transport channels of present London, relieved of congestion by a few motorway distributive loops, we should be a step further towards a real modern solution of the central city areas.

Yours faithfully,

W. FISHER CASSIE.

Department of Civil Engineering,
(Highway and Traffic Engineering Section),
University of Durham,
Newcastle upon Tyne, 2.
14 November, 1960.

Selecting Future Foremen

SIR, It has been interesting to study the report in the second article on your national survey on the foreman problem "Foremen: Leaders or Not?" (ENGNG., 14 Oct. '60, p. 505). The issues are so near to those that lead this College, in collaboration with the Vickers Group and other companies, to launch a supervisory training programme that I am very keen to learn all I can of the thinking that was behind your survey.

May I put to you some thoughts on a National College for Foreman Training (ENGNG., 7 Oct. '60, p. 478)? I hope that, before any separate foundation is considered, the promoters of the scheme will ask themselves whether this task cannot be done more effectively, economically and promptly in being geared to the nation-wide scheme of technical training established in technical colleges by local education authorities. There is some danger that preoccupation with the problem of Diplomas in Management and the need to raise their standards may lead us to neglect an organic relationship between colleges and companies for a different and more intensive type of training for personnel who may not be interested and will not be eligible for Diploma courses.

Whether this be centralised in one college, or decentralised to incorporate several, it should have two qualities: (*a*) residential and continuous training (staged courses of three weeks or weekends at intervals will suffice); and (*b*) partnership between college and industry in the devising of courses, presentation of subject matter and (in order to get a variety of firms, age and functions) selection.

Eight years of successful collaboration between this College and national industrial organisations and with neighbouring companies convinces me that this can be done. Frankly, it is not a relationship which always fits in very tidily with the usual pattern of technical college courses but, with goodwill and imagination (in which we have been fortunate), a link between college and industry is created that seems to me to be badly needed. It is all too easy to understand a preference in some business circles for the "independent" venture but this will only dilute the available skill still further and separate the colleges still further from industry.

Yours sincerely,

JOHN DAVISON,
Head of Department.

Department of Management Studies,
Brooklands County Technical College,
Weybridge.
10 November, 1960.

Television Definition

SIR, Your reviewer of the British Broadcasting Corporation's *Television Field Trials of 405-line and 625-line Systems* (ENGNG., 4 Nov. '60, p. 618), and any of your readers who "are not normally conscious of the presence of the lines" are obviously overdue for a visit to their opticians or need to change their opticians. They are missing a great deal of interesting detail in the world around them outside the small screen.

I imagine that about a thousand lines would be necessary to render me unconscious of them.

I should prefer, however, to see a television picture scanned in 625 lines alternately in two different directions at 90° to each other.

Yours faithfully,

R. B. BULMAN.

Carlisle.
8 November, 1960.

University Reactor Licences

SIR, In your current issue you report the granting of a nuclear site licence to Queen Mary College, with the implication that the College can now go ahead with construction (ENGNG., 11 Nov.'60, p. 648).

If the experience of Imperial College is a precedent, this is unfortunately far from true. This College received a similar nuclear site licence, from the Minister of Power, as long ago as last April, and had previously received complete technical approval of its project at all levels of the many bodies who from time to time were involved in judging its merit. What has not been received, by this College or any other, is financial sanction.

Yours faithfully,

J. M. KAY,
Professor of Nuclear Power.
C. G. JAMES,
Lecturer in Nuclear Power.

Department of Mechanical Engineering,
Imperial College of Science and Technology,
London, SW7.
14 November, 1960.

A Bridgehead for Trade?

SIR, I should like to express my appreciation of your article entitled "Czechoslovakia: A Bridgehead for Trade?" (ENGNG., 30 Sept. '60, p. 438), which included such a valuable summary of the problems facing an exporter to Czechoslovakia, and no doubt a grasp of these problems would be useful to exporters to many other Communist countries.

Nevertheless, I have an unworthy suspicion

that the heading and the final paragraph are misleading. Surely Czechoslovakia cannot be a bridgehead for trade—a promising potential market certainly; a useful training ground for exporters who wish to find out how Communist importers work perhaps—but surely Czechoslovakia does not act as a purchasing agent for the Eastern Bloc, so how a bridgehead? Does Mr. E. P. Ward think that the reputation of British equipment will percolate horizontally through the interstices of the Communist "apparatus" into Russia, Hungary, and so forth?

In short, what I am respectfully suggesting is that the British exporter should tackle Communist countries direct on the lines suggested by Mr. Ward and not by using Czechoslovakia as a bridgehead.

Yours faithfully,
R. M. A. BRAINE,
Chairman.

Conforex Limited,
London, SW1.
9 November, 1960.

Events in Advance

Supervisors in Industry, Residential Course for.—Sat., 3 Dec., to Sat., 10 Dec., at Madingley Hall, near Cambridge. Organised by the Board of Extra-Mural Studies, the University of Cambridge, Stuart House, Cambridge. Tel. Cambridge 56275.

Sports Goods Fair, International.—Mon. and Tues., 2 and 3 Jan., 1961, at Wiesbaden. Organised by the Verband Deutscher Sportsgeschafte e.v., 182A Markstrasse, Krefeld-Rheinland, Germany.

Boat Show, Seventh International.—Wed., 4 Jan., to Sat., 14 Jan., 1961, at Earl's Court, London, SW5. Organised by the Ship and Boat Builders' National Federation, 23 Knightsbridge, London, SW1. Tel. BELgravia 6402.

Camping and Outdoor Life Exhibition.—Wed., 4 Jan., to Sat., 14 Jan., 1961, at the Empire Hall, Olympia, London, W14. Organised by Trade Exhibitions Ltd., Exhibition House, 4 Spring Street, London, W2. Tel. AMBassador 5421.

Rocket Propulsion, Two-Day Symposium.—Fri. and Sat., 6 and 7 Jan., 1961, at the College of Aeronautics, Cranfield. Organised jointly by the College of Aeronautics, Cranfield, Bucks. (Tel. Cranfield 321); the Royal Aeronautical Society, 4 Hamilton Place, London, W1 (Tel. GROsvenor 3515); and the British Interplanetary Society, 12 Bessborough Gardens, London, SW1. Tel. TATe Gallery 9371.

Sports Goods, Camping Equipment and Garden Furniture; International Fair of (SPOGA).—Fri., 6 Jan., to Mon., 9 Jan., 1961, in Cologne. Inquiries in the United Kingdom should be sent to Mr. Neven du Mont, 123 Pall Mall, London, SW1. Tel. WHItehall 8211.

Meetings and Papers

Association of Supervising Electrical Engineers

BRISTOL
"Heavy Industry Control Gear," Discussion. Bristol and West of England Branch. Grand Hotel, Bristol. Mon., 21 Nov., 8 p.m.

British Institution of Radio Engineers

LONDON
"Objective and Subjective Requirements for Loudspeakers," by F. H. Brittain. Electro-Acoustics Group. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Wed., 23 Nov., 6.30 p.m.*

BIRMINGHAM
"The Various Routes to Professional Qualifications in Electronic Engineering": Discussion. West Midlands Section. The University, Edgbaston, Birmingham. Wed., 23 Nov., 6.15 p.m.

BRISTOL
"Transistors in Control Circuits," by E. Wolfendale. South Western Section. School of Management Studies, Unity Street, Bristol. Tues., 22 Nov., 7 p.m.

Combustion Engineering Association

BIRMINGHAM
"The Factories Acts in Relation to Boilers and Pressure Vessels": Discussion to be opened by H. Entwistle. Midland Region. Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham 2. Wed., 23 Nov., 10.30 a.m.

MANCHESTER
"Automatic Control of Coal-Fired Plant," by H. B. Weston. North Western Region. Engineers' Club, Albert Square, Manchester. Tues., 22 Nov., 2.30 p.m.

Illuminating Engineering Society

LEEDS
"Eye Strain and Glare Disabilities in Relation to Artificial Lighting," by G. Black. Leeds Centre. British Lighting Council, 24 Aire Street, Leeds 1. Mon., 21 Nov., 6.15 p.m.

Institute of Marine Engineers

LONDON
"Automatic Control of Naval Boilers," by Commander J. P. H. Brown and Lieutenant Commander W. J. R. Thomas. Tues., 22 Nov., 5.30 p.m.*

DAGENHAM
"Atomic Energy," by Dr. L. Bovey. Junior Lecture. South East Essex Technical College, Longbridge Road, Dagenham. Wed., 23 Nov., 2.30 p.m.

Institute of Road Transport Engineers

PRESTON
"Glass Fibre Reinforced Plastics," by G. O. Gurney. Northern Centre. Victoria and Station Hotel, Preston. Wed., 23 Nov., 7.30 p.m.

Institution of Civil Engineers

LONDON
"The Operation of the General Conditions of Contract for Works of Civil Engineering Construction": Discussion, to be introduced by A. M. Holbein. Thurs., 24 Nov., 5.30 p.m.*

Institution of Civil Engineers and Institution of Electrical Engineers

LONDON
"The Aswan Hydro-Electric Scheme," by Valter Furuskog and Geoffrey Kennedy. At Institution of Civil Engineers, Great George Street, SW1. Tues., 22 Nov., 5.30 p.m.*

Institution of Electrical Engineers

LONDON
"Magnetic Amplifiers in Power Engineering," by M. J. Pope. London Graduate and Student Section. Mon., 21 Nov., 6.30 p.m.*

GLASGOW
"A Survey of Street Lighting and Its Future," by W. R. Stevens and H. M. Ferguson. South West Scotland Subcentre. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2. Wed., 23 Nov., 6 p.m.*

NEWCASTLE UPON TYNE
"Radio Communication in the Power Industry," by E. H. Cox and R. E. Martin. North Eastern Centre. Neville Hall, Westgate Road, Newcastle upon Tyne. Mon., 21 Nov., 6.15 p.m.

Institution of Heating and Ventilating Engineers

LONDON
"Application of Pneumatic Controls to Air Conditioning, with Special Reference to High-Velocity Air Conditioning," by G. F. Brown. Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, SW1. Thurs., 24 Nov., 6 p.m.*

BIRMINGHAM
"A New Approach to Hot-Water Pipe Sizing," by E. W. Shaw. Birmingham Branch. Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham 2. Graduates' Evening. Tues., 22 Nov., 6.30 p.m.

Institution of Highway Engineers

WHITEHAVEN
"Bridges in the West Riding, with Particular Reference to the Wentbridge Viaduct," by N. H. Buchi. Northern Branch. Union Hall, Whitehaven. Fri., 25 Nov., 7 p.m.

Institution of Mechanical Engineers

LONDON
"Bearing Corrosion": Discussion. Lubrication Group. Tues., 22 Nov., 6 p.m.*
"Blaenau Ffestiniog and Other Medium-Head Pumped Storage Schemes in Great Britain," by H. Headland. Nominated Lecture. Wed., 23 Nov., 6 p.m.*

BEDFORD
"Developments in High Nickel Alloys for Heat and Corrosion Resistance," by J. Hinde. Eastern Branch. Dujon Restaurant, Bedford. Tues., 22 Nov., 7.30 p.m.

NEWCASTLE UPON TYNE
"Relation Between the Critical Alternating Propagation Stress and Crack Length for Mild Steel," by N. E. Frost. North Eastern Branch. Stephenson Building, Claremont Road, Newcastle upon Tyne. Thurs., 24 Nov., 6.15 p.m.

RUGBY
"Future of Air-Breathing Engines in Aviation," by S. G. Hooker. Repetition of a James Clayton Lecture. College of Engineering Technology, Rugby. Tues., 22 Nov., 6.30 p.m.

Institution of Plant Engineers

BIRMINGHAM
"British Railways Electrification Scheme," by W. B. Marrian. Birmingham Branch. Imperial Hotel, Temple Street, Birmingham. Fri., 25 Nov., 7.30 p.m.

CHESTER
"Breakdowns: Another Year of Case History," by J. Sword. Merseyside and North Wales Branch. The Blossoms, Chester. Thurs., 24 Nov., 7.15 p.m.

SHEFFIELD
"Introduction of Planned Maintenance Systems," by A. F. Stedman. Sheffield Branch. Grand Hotel, Sheffield. Thurs., 24 Nov., 7.30 p.m.

Institution of Production Engineers

MANCHESTER
"Machine Tool Development, as Seen at Olympia, 1960" by Norman Stubbs. Manchester Section. Reynolds Hall, Manchester College of Science, Manchester. Mon., 28 Nov., 7.15 p.m.

Institution of the Rubber Industry

BATH
"Colours: Their Uses and Developments," by H. G. White. West of England Section. Joint meeting with the Plastics Institute. Royal York Hotel, Bath. Wed., 23 Nov., 8 p.m.

Institution of Structural Engineers

BIRMINGHAM
"The Architect and the Developer," by J. Seymour Harris. Midland Counties Branch. College of Advanced Technology, Gosta Green, Birmingham. Fri., 25 Nov., 6.30 p.m.

Junior Institution of Engineers

LONDON
Annual General Meeting and Annual General Meeting of the Benevolent Fund. Fri., 25 Nov., 7 p.m.*

King's College, University of London

LONDON
"Vibration Mills and Vibration Milling," by Dr. H. E. Rose. Last of a series of three public lectures. Wed., 23 Nov., 5.30 p.m. (No tickets required.)

Manchester Metallurgical Society

MANCHESTER
"New Aspects of the Electron Theory of Metals," by Professor G. V. Raynor. Offices of the Manchester Literary and Philosophical Society, George Street, Manchester. Wed., 23 Nov., 6.30 p.m.

Reinforced Concrete Association

BIRMINGHAM
"Brazil, Venezuela and Mexico," by A. J. Gordon. Midland Counties Branch. Birmingham and Midland Institute, Paradise Street, Birmingham. Tues., 22 Nov., 6 p.m.*

Royal Institution of Chartered Surveyors

NOTTINGHAM
"Offshore Mineral Exploration," by R. H. Garnett. Welbeck Hotel, Nottingham. Sat., 26 Nov., 10.30 a.m.

Royal Society of Arts

LONDON
"Traffic and Parking Problems," by A. Samuels. Wed., 30 Nov., 6 p.m.

Royal Statistical Society

BIRMINGHAM
"Public Opinion Polls," by C. A. Moser. Birmingham Group. Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham 2. Mon., 21 Nov., 6.15 p.m.*

EDINBURGH
"Statistical Methods as Aids to Business Management," by T. Hunter-Thomson. Edinburgh Group. 25 Charlotte Square, Edinburgh. Mon., 21 Nov., 7.30 p.m.

GLASGOW
"Some Problems of Sampling for Large-Scale Inquiries," by P. J. Lane. Glasgow Group. Royal College of Science and Technology, Glasgow, C1. Wed., 23 Nov., 7.30 p.m.

Royal United Service Institution

LONDON
"The Education of the Officer," by Major-General J. W. Hackett. Wed., 23 Nov., 3 p.m.

Sheffield Metallurgical Association

SHEFFIELD
"Some Aspects of Research for Steel Foundries," by Dr. A. H. Sully. BISRA Laboratories, Hoyle Street, Sheffield. Tues., 22 Nov., 7 p.m.

Society of Environmental Engineers

LONDON
"Vibration Testing and Instrumentation in Large Stores": Discussion. Imperial College, South Kensington, SW7. Wed., 23 Nov., 6 p.m.

Society of Instrument Technology

CARDIFF
"Application and Selection of Automatic Control Valves," by P. Stone. South Wales Section. Welsh College of Advanced Technology, Cardiff. Wed., 30 Nov., 6.45 p.m.

CHELTENHAM
"Operation and Control of ERNIE": Discussion. Cheltenham Section. Belle Vue Hotel, Cheltenham. Tues., 22 Nov., 7.30 p.m.

GLASGOW
"Instrumentation of a Space Vehicle," by Dr. A. E. Roy. Scottish Section. The University, Glasgow. Fri., 25 Nov., 7.15 p.m.

WIRRAL
"Maintenance and Operational Experience of a Data-Logging Installation," by D. C. Austin. Chester Section. Administration Building, Associated Ethyl Co., Ltd., Oil Sites Road, Ellesmere Port, Wirral. Thurs., 24 Nov., 7 p.m.

Television Society

LONDON
"Measurement Techniques for Television Broadcasting," by L. E. Weaver and I. J. Shelley. Cinematograph Exhibitors' Association, 164 Shaftesbury Avenue, WC2. Fri., 25 Nov., 7 p.m.

Women's Engineering Society

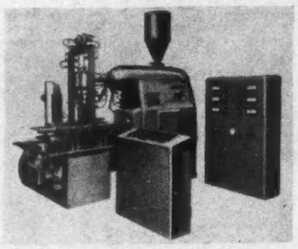
MANCHESTER
"Radiation in Industry," by M. C. Crowley Milling. Manchester Branch. Manchester Society of Chartered Accountants, 46 Fountain Street, Manchester 2. Wed., 23 Nov., 7 p.m.

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. An asterisk (*) is placed where it is understood that refreshments are available prior to the time stated.

Association of Supervising Electrical Engineers, 23 Bloomsbury Square, London, WC1. (LANgham 5927)
British Institution of Radio Engineers, 9 Bedford Square, London, WC1. (MUSeum 1901)
Combustion Engineering Association, 70 Jermyn Street, St. James's, London, SW1. (WHItehall 5536)
Illuminating Engineering Society, 32 Victoria Street, London, SW1. (ABBey 5215)
Institute of Marine Engineers, Memorial Building, 76 Mark Lane, London, EC3. (ROYal 8493)
Institute of Road Transport Engineers, 69 Victoria Street, London, SW1. (ABBey 6248)
Institution of Civil Engineers, Great George Street, London, SW1. (WHItehall 4577)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (COVent Garden 1871)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London, SW1. (SLOane 3158)
Institution of Highway Engineers, 47 Victoria Street, London, SW1. (ABBey 3891)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. (WHItehall 7476)
Institution of Plant Engineers, 2 Grosvenor Gardens, London, SW1. (SLOane 0469)
Institution of Production Engineers, 10 Chesterfield Street, London, W1. (GROsvenor 5254)
Institution of the Rubber Industry, 4 Kensington Palace Gardens, London, W8. (BAYswater 9101)
Institution of Structural Engineers, 11 Upper Belgrave Street, London, SW1. (SLOane 7128)
Junior Institution of Engineers, Pepys House, 14 Rochester Row, London, SW1. (VICtoria 0786)
King's College (University of London), Strand, London, WC2. (TEMple Bar 5454)
Manchester Metallurgical Society, The Kennedy Press, Ltd., 31 King Street West, Manchester 3.
Reinforced Concrete Association, 94-98 Petty France, London, SW1. (ABBey 4504)
Royal Institution of Chartered Surveyors, 12 Great George Street, London, SW1. (WHItehall 5322)
Royal Society of Arts, John Adam Street, Adelphi, London, WC2. (TRAfalgar 2366)
Royal Statistical Society, 21 Bentinck Street, London, W1. (WELbeck 7638)
Royal United Service Institution, Whitehall, London, SW1. (WHItehall 5854)
Sheffield Metallurgical Association, 64 Crescent Road, Sheffield 7. (Sheffield 52865)
Society of Environmetal Engineers, 42 Manchester Street, London, W1. (HUNter 2080)
Society of Instrument Technology, 20 Queen Anne Street, London, W1. (LANgham 4251)
Television Society, 166 Shaftesbury Avenue, London, WC2 (TEMple Bar 3330)
Women's Engineering Society, 25 Foubert's Place, London, W1. (GERrard 5212)

BLOW MOULDER

Single or Double Head



THE Fischer BM500S blow moulding machine shown in the illustration can have either one or two vertical heads.

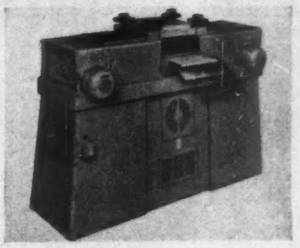
The main units making the complete machine are: extruder; vertical head; blow moulding mechanism; thread forming device; discharge conveyor; blowing mechanism; hydraulic equipment; and electrical control desk. A single head will produce one hollow article up to 1,000 c.c. per cycle and the two heads will each produce one article of 500 c.c. Where the shape of the article is irregular the capacity may be as much as 3,500 c.c.

Dies and mandrels for heads are interchangeable and are divided into several heating zones. The blow moulding mechanism has two movable platens, hydraulically operated. When closed an intensifier builds up the pressure to 4 tons. The thread forming device is immediately above the closing mechanism and consists of a welded frame with support plates for forming bars.

The discharge conveyor is a short endless belt to remove the formed articles. A longer one can be provided to allow a greater cooling period if required. The blowing mechanism consists of a long tube passing through each extrusion head. The end of the tube forms the sizing die for the internal diameter of the neck of hollow articles, and other tubes are used for inflating the plastic and for water cooling. A Vickers pump with a capacity of 36 litres per minute at 50 atmospheres supplies the hydraulic circuits. All the controls are on the main panel for both automatic and separate operations. *Matthew Wylie and Company Limited, Portman Street, Glasgow, S1.*

FLATTENER

For Component Blanks



BLANKS for components can be automatically flattened in the Schubert WM2 machine now available in this country.

The machine is intended to replace both manual flattening which needs a skilled operator, and planishing tools which can only be used on a limited range of parts. The Schubert machine uses rollers with adjustable pressure so that the stress in the blanks can be controlled to lie within the narrow range between the elastic limit and the yield point of the material.

It is claimed that the accuracy that can normally be obtained in the machine is to 0·0008 in, achieved in two passes. The thickness of the piece is not altered by the process.

All the working parts are housed in a floating frame within the machine to afford quiet running. The motors drive distributor boxes through reduction gears, and power is transmitted to the roller frame by shafts with universal joints. The flattening rollers are lapped and run on needle roller bearings. All wearing parts are easily replaceable. Regulation is by four handwheels and dial indicators and setting can be readily repeated.

The range of workpieces that the machine will handle is from 1 in long upwards and less than 13¼ in in breadth. The thickness should be in the range from $\frac{1}{16}$ in to $\frac{1}{2}$ in. Output depending on the size of the blank is from 200 to 1,500 per hour. The power consumption is about 3·5 kW. Blanks can be of steel, light, or heavy metal and may be soft, case hardened or nitrided. *Vaughan Associates Limited, 4 Queen Street, Curzon Street, London, W1.*

HIGH SPEED ANGLE GRINDER

9 in Disc

CLAIMS for a new high speed angle grinder are ease of control and electrical safety.

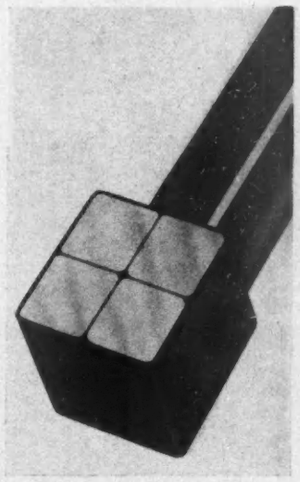
The motor, which is available for all standard voltages on both a.c. and d.c., is shrouded in a polyester resin with glass fibre insulating material which acts as a second layer of insulation and brings the grinder up to full CEE standards. The motor is cooled by air blown through special ducts over the field and armature, eliminating metallic build-up and keeping the operating temperature low.

Discs can be easily changed by the use of a spindle locking stud, and the disc guard can be moved around to any required position. Model DI-J7 will take a 7 in disc and model DI-J9 a 9 in one. Both can be fitted with cut-off wheels which are suitable for material up to 1 in thick. Running speeds (light) of the two models are 8,000 and 6,000 r.p.m. respectively, falling to 6,250 and 4,800 r.p.m. on load. Consumption is 1,400 watts. Overall length of both models is 16¾ in and the weights complete with grinding discs are 16½ lb and 17¼ lb.

It is particularly claimed that the position of the handles gives a comfortable hold and an even distribution of weight. *Wolf Electric Tools Limited, Hanger Lane, London W5.*

COOLING UNIT

Thermoelectric



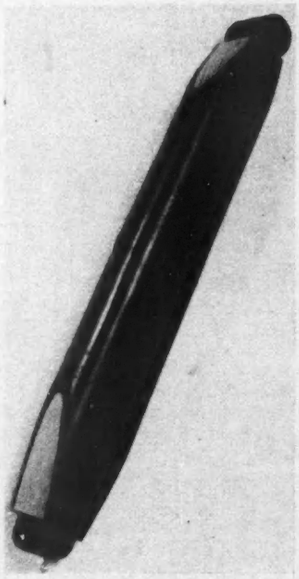
NOW on the market is a basic thermoelectric cooling unit for direct incorporation in apparatus.

The first of the range is the BT4 illustrated which has four junctions and a nominal rated cooling capacity of 1 watt. This value can, however, be increased with resultant reduction in temperature depression, and vice versa. Models with ratings of 10 W and above will later be available. For 1 W extraction the power input required is approximately 3 W at a nominal current of 10 A.

The BT4 unit measures ½ in square over the working face and is $\frac{15}{32}$ in deep. The face is designed to fit directly on to the surface to be cooled, and there is no covering plate which would reduce the efficiency by introducing an additional interface junction. A heat sink must be provided at the back. A typical temperature differential that can be obtained by one of these 1 W units is 25° C. The intention is to provide a basic unit that can be fitted to many applications, and capable of slight modification to suit each one. *Salford Electrical Instrument Limited, Silk Street, Salford 3, Lancashire.*

ABRASIVE HOLDER

For Hand Finishing



ILLUSTRATED is an abrasive holder for strips of emery cloth.

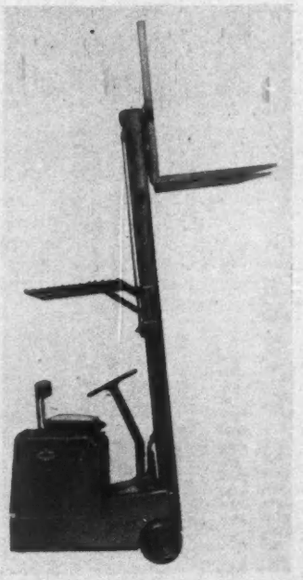
The holder is designed to take strips 1 in wide of any grade of grit. It is claimed that its use will reduce the risk of injury during hand finishing operations on power tools. It provides a firm support for the emery cloth and the rounded ends allow access to small radii curves.

The body of the holder consists of a neoprene rubber moulding with the ends shaped to different curvatures. The two identical side members are also of neoprene and have a core of hard wood shaped to fit the body and tapered at the ends to give a smooth finish. The overall length of the holder is 12 in.

The strip can be rapidly changed by opening the side members and inserting the new length. A light grip clamps it in place. Two strips of different grades can be loaded at the same time, one each end, for roughing and finishing. *Silvaflame Company Limited, 218A Monument Road, Birmingham 16.*

FORK LIFT TRUCK

15 Cwt Capacity



BATTERY operated, a new Ministack fork lift truck has a capacity of 15 cwt at 20 in centres or 13 cwt at 24 in centres. Height of lift is 12 ft.

The electrically-welded all-steel rigid chassis is a one piece unit. The steel telescopic mast assembly can be tilted 3° forward and 8° back under hydraulic control. All controls are in easy reach of the driver and the steering is designed for light operation; it has a 180° lock. The pump motor is automatically started by operating the sensitive hoist control valve.

The truck has a maximum forward speed of 5 m.p.h. under pedal control, with hydraulic brakes on the front wheels also pedal operated. A safety interlock prevents operation if the hand brake is on, and another prevents use while the built-in charger is connected. An interlock can also be fitted to cut off all controls if the driver's weight is removed from the seat. *Montgomerie Reid Engineering Company Limited, Bramley, nr. Basingstoke, Hampshire.*

Public Works Exhibition

Olympia, London, 14 - 19 November

The official opening of the Exhibition was at noon on 14 November by Mr. Henry Brooke, the Minister of Housing. So much more machinery is now being used in building and allied trades that it is not surprising to have all the available space in Olympia occupied. There are in fact 670 stands representing nearly every type of machine and equipment for building a bungalow or a motorway. Some of the exhibits were reported in the issue of 11 November.

TRACTOR SHOVEL

A NEWCOMER to the list of tractor shovels is a 2½ cu. ft model, the TS 250.

The standard bucket is 2½ cu. yd capacity and the action is fully hydraulic. Fulcrum pads on the boom arms behind the bucket provide powerful leverage for digging, and 40° tilt back allows a full load to be carried without spillage, while yet keeping it close to ground level to assist in overall stability. The maximum dumping height of 10 ft is reached in 8½ seconds. At 7 ft dumping height the reach is 4 ft 9 in from the front of the tyres.

Power is supplied to all four wheels by either Rolls-Royce or Leyland diesel engines. The drive is through a power shift transmission giving two working speeds in both directions, and four forward and four reverse travelling speeds. A single stage Twin-Disc torque converter is used. Both axles incorporate Timken Hi-traction differentials and planetary final drives. A clutch is provided to enable the front axle to be disconnected for road travel. Four-wheel hydraulic service brakes have Hydrovac power boost and the mechanical parking brake acts on the front drive shaft. *Aveling-Barford Limited, Grantham.*

DUMP TRUCK

25,000 lb Payload

A RECENT addition to the Eimco range is the model 850 dump truck which has a capacity of 9 cu. yd.

The truck is powered by a Leyland AU600/35A six cylinder diesel engine developing 150 h.p. The body is designed for heavy duty rock handling and is of welded construction with internal and external reinforcement. It has a wide mouth and a low lip for easy loading and gives a 70° discharge angle when fully tipped by the hydraulic rams. The straight floor run assists in the discharge of sticky materials. The payload is 25,000 lb. The chassis and yoke are heavy duty rolled steel sections with welded fabrication throughout.

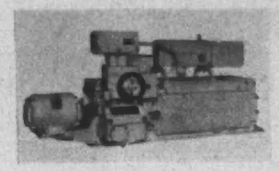
The transmission includes a dry single plate heavy duty 16 in clutch and there is an independently mounted constant mesh gearbox giving five forward speeds and one reverse with remote control from the cab. The speed range varies from 3 m.p.h. in first gear to 24 m.p.h. in top. A gradient of 1 in

4 can be climbed with full load.

Four hydraulic rams controlled by the steering wheel give a 180° swing under finger-tip control, and also ensure self centring action. The turning circle of 22 ft 9 in obtained by the articulation gives the vehicle great manoeuvrability. Foot controlled air brakes operate on all four wheels and a mechanical hand brake operating on the driving wheels is fitted as standard equipment. Hard rock lug 16·00 by 25 by 24 ply tyres are interchangeable on front and rear wheels. The main dimensions of the truck are 24 ft 5½ in long by 8 ft 5 in wide by 8 ft 6¼ in high. *Mackay Industrial Equipment Limited, Faggs Road, Feltham, Middlesex.*

SCALE FEEDER

Electric Operation



HIGH accuracy and dependability are two claims for the Merchen scale feeders.

The model illustrated is an electric version; a pneumatically operated model is also available. The material is placed in the central hopper and fed down to the belt through an adjustable inlet gate moving vertically. The belt moves at constant speed and is supported on either side of the weighing section by fixed platforms that prevent shock loading.

The weighing section is only 15 in long and consists of two skeleton decks hinged on flexure pivots for reliability, and connecting with the scale arm at their common centre point. The short length makes belt sag insignificant and the thin belt eliminates errors due to stiffness. Aluminium construction reduces inertia.

The beam action is mechanically independent of the control system. The feed rate is steplessly adjustable by moving the poise weight which has a lead screw setting. The beam balance indicator is always visible. The feed control gate is driven from the weighbelt drive.

Microswitches actuated from the position of the feed gate give over and under feed protection. They may be used for feeder control or for alarms. A feed rate indicator reads to five digits in terms of weight per unit of time and a six digit counter registers the total feed.

A ¼ h.p. synchronous motor drives the belt through positive drive rollers. The maximum feed rate is generally governed by the gravimetric limit and can be from 3 to 3,000 lb per hour. When governed by the volume (that is, with very light materials) the capacity is from 0·5 to 10 cu. ft per minute with a 9 in belt and up to 60 cu. ft per minute with an 18 in belt. *Wallace and Tiernan Limited, Power Road, London, W4.*

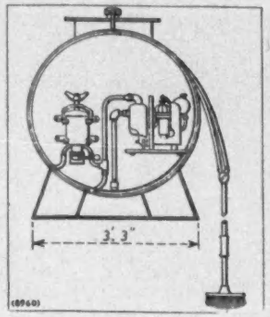
MOBILE WASHER

Trailer or Truck Mounted

THE M1 mobile washing unit was designed primarily for cleaning street signs but is now being used for many other items as well.

The illustration shows the vehicle-mounted version. There is a similar model for trailer mounting and a smaller one of 100 gallons capacity for mounting on a Lambretta three-wheeler. The standard model has a tank capacity of 250 gallons and is constructed of ¼ in steel plate. The width across the cradles is 3 ft 3 in and the overall length of the tank including the pump unit is approximately 6 ft 6 in. A standard 18 in manhole is centrally mounted on the top of the tank to provide access to the interior. A 2 in BSP knurled pipe forms a filling connection.

The pump unit is driven by a two stroke petrol engine and the water is forced either through a detergent foam unit or direct along the 60 ft length of hose to the cleaning brush which is mounted on the end of a 6 ft rigid extension piece.



A gate valve is provided on the feed pipe from the tank to the pump so that the former can be isolated.

Where the twin hoses join the extension piece there is a two way valve that selects foam or clear water as required. The twin hose is ½ in bore plastic, and is normally kept wound round the tank. The capacity of 250 gallons gives a considerable operating "range" without refilling. The Lambretta model is more suitable for areas where frequent refilling is possible, as well as for confined conditions. *J. S. Webber Limited, 6 Stanley Road, London, E4.*

DRAG SHOVEL

Alternative Attachments

THE NU 1620 is a ¾ cu. yd excavator which can be used as a drag shovel, dragline, face shovel, or crawler mounted crane.

The crawler frame is a heavy duty structure fabricated from rolled steel sections with one-piece end castings to retain alignment of shafts. The drive sprockets are driven by involute splines. The multiple hinged crawler shoes are cast steel and self aligning; swamp cleats can be added quickly and easily. Adjustment screws are provided to align end shaft bearings, tracks and drag chains.

Automatic traction brakes are fitted providing a friction type locking device for both crawlers. They are self engaged by spring action and release automatically when power is applied. The drive shaft and travel gears are totally enclosed. The turntable and machinery deck are mounted on a ball bearing swing ring.

The Ford 590E engine is coupled directly to the main machinery through a worm box, thereby eliminating chains and reducing the number of moving parts. Another exclusive feature is the one-piece cast machinery case, totally enclosing all shafts and gears. Raising and lowering of the boom is by an independent worm drive.

As a drag shovel, the Neal-Unit has a ¾ yd bucket, a digger width over the side cutters of 39½ in and a depth rating of 45° angle of 18 ft 11½ in. As a face shovel the cutting radius for a boom angle of 45° is 29 ft 4 in and the height 24 ft 11in. It will cut 6 ft 1 in below ground level. In the dragline version there are three booms of 35, 40 and 45 ft, the last giving a working radius up to 42 ft 9 in and height of 26 ft 8 in. Arranged as a crane it will lift 31,400 lb on a 35 ft boom at 10 ft radius or 9,860 lb on a 75 ft boom at 20 ft radius. *R. H. Neal and Company Limited, Plant House, Ealing, London, W5.*

DRILLING RIG

Crawler Mounted

THE illustration shows the Holtrac crawler mounted drill rig that will carry a heavy drifter.

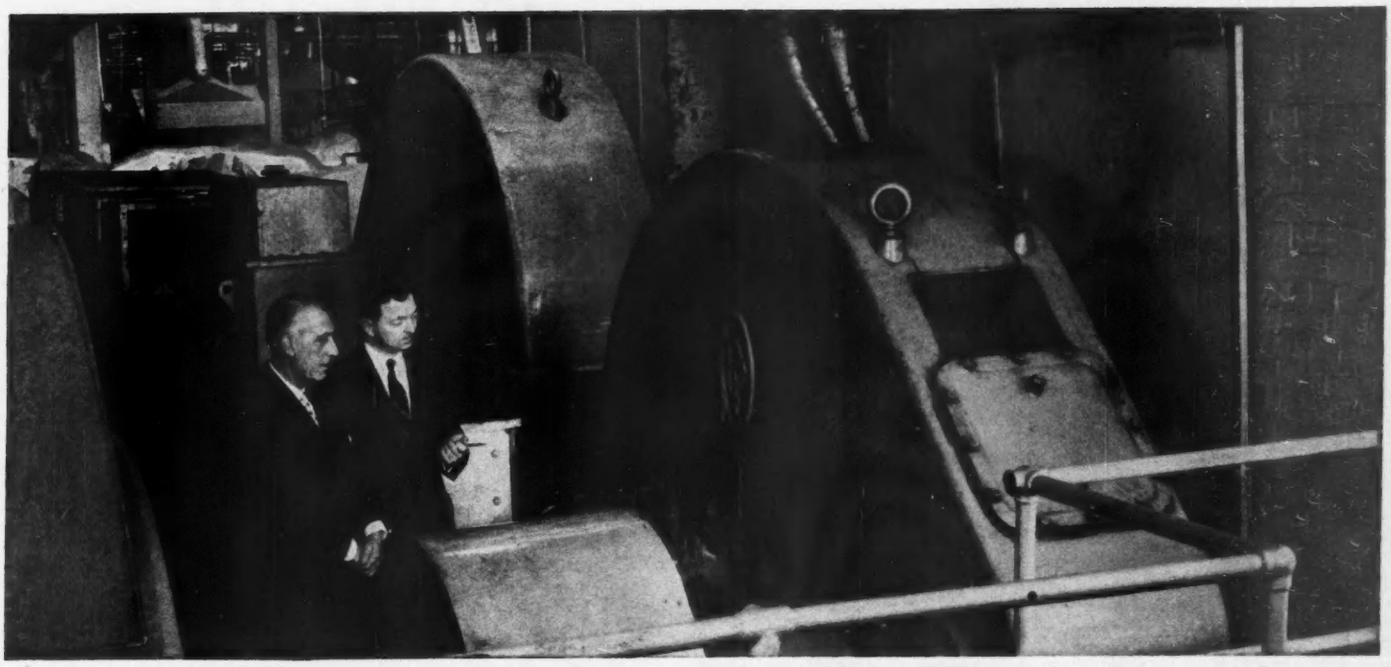
The power unit is a combination of two 5R Rotomotors each of 7½ h.p. They drive through an eight plate "Bristol Tractor" clutch. An articulated action system allows maximum track oscillation so that all types of ground conditions met with in mines and quarries can be traversed while maintaining stability and manoeuvrability. Laminated rubber track pads can be supplied if required.

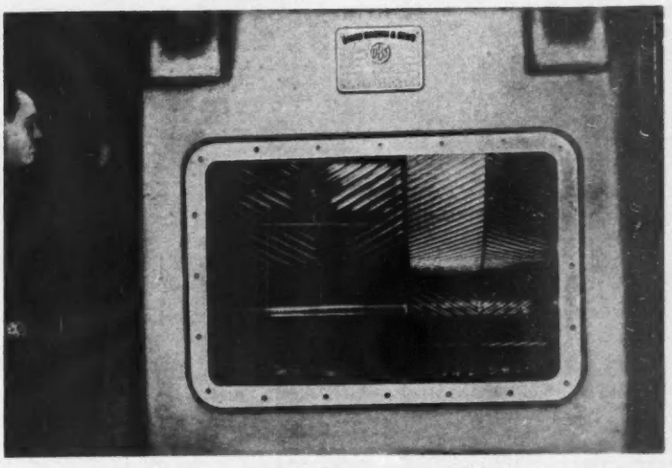
All hydraulic and pneumatic controls for the carriage are concentrated on one panel and dual control for the drifter and the feed motor is provided at the sides. The unit is capable of towing an air compressor making it self sufficient, and can then be operated by one man.

Boom movement and feed positioning are fingertip controlled and permit pattern drilling at almost any angle. The hydraulic movements include elevating, lowering and slewing of the boom and dumping, swinging, and crowding of the drill carriage.

The reach obtainable is such that breast holes 8 ft 9 in above ground level and spaced 7 ft 6 in apart can be drilled from one setting. The controls include a deadmans device that returns all levers to neutral and applies the brakes, and a pedal operated air valve that can only be reached from the driving seat is an additional safety feature. *Holman Brothers Limited, Camborne, Cornwall.*

Dunlop choose Regent lubricants for these gears!





(Top) Regent Sales Engineers at the Dunlop factory, Birmingham.
(Inset) The 600 H.P. Double Reduction Speed Reducer in this picture at the Dunlop factory in Birmingham is driving a Mixer. Dunlop have found Regent Oil ideal for the efficient lubrication of these gears.
For further information and advice on gear lubrication send off the coupon below

Fifty years of research and improvement have gone into the development of Regent Gear Lubricants—a half century of experience which has produced gear lubricants tailored to meet the most exacting industrial needs. That is why so many modern companies, like Dunlop, use Regent Gear Lubricants in one or all of these forms:—

CRATER... a powerful many-purpose lubricant without equal for heavy duty and exposed applications. All grades have excellent adhesive qualities. Compounded blends are available for operations under wet conditions—even under water. Also available are Crater Fluids permitting easy initial application but retaining their powers of adherence.

MEROPA ... lead base lubricant for high tooth pressures, has built-in protection against wear under continuous heavy duty and shock loading. Meropa is guaranteed non-corrosive in conditions of mild humidity and moisture. There is a full range of viscosities to meet all conditions.

THUBAN ... a first-quality, straight mineral gear lubricant, for maximum protection of rubbing surfaces under normal, and up to heavy duty loading, conditions.

Regent Oil Company Limited, 117 Park Street, London, W.1

☐ I would like a Regent representative to call.

☐ I would like a copy of the Gearing Lubrication Leaflet.

(Tick whichever applicable)

NAME_____

COMPANY ADDRESS_____

_____

_____

POSITION IN COMPANY_____

E3

No. 1071
G.M. Gate Valve

No. 1028B
Globe Steam Valve

No. 1031
G.M. Globe Valve

Top value in steam valves -from Peglers

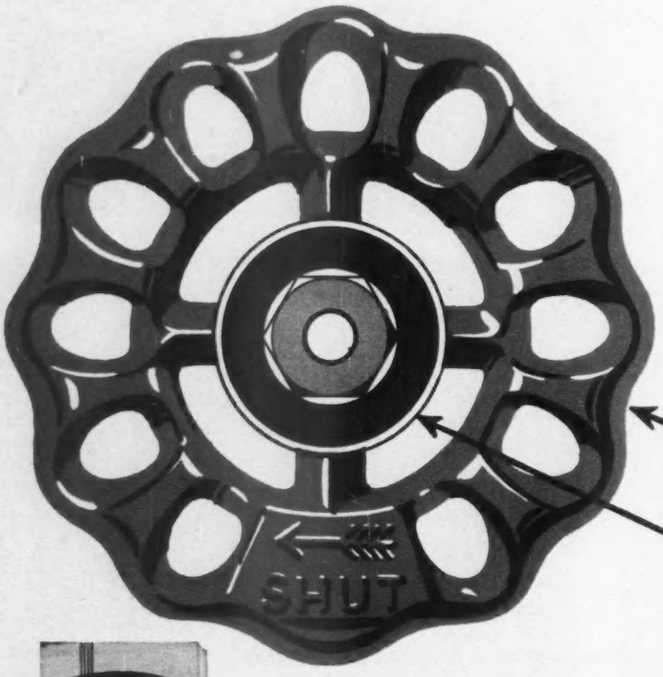
(Left) *To* B.S. 1952. *With flanged ends.*

(Centre) *Renewable stainless steel seat and valve, 300 p.s.i. Up to 600°F. The most reliable valve of its class ever produced.*

(Right) *With metal seat. Produced to* B.S. 2060.

UP TO 'BS' AND BEYOND!

High quality—in workmanship, materials, valve design . . . This is a characteristic of *all* Peglers steam valves. Whilst most are produced to B.S. standards, some stock valves, such as the highly-advanced 1028B steam stop valve, actually go beyond B.S. requirements!



NEW Advanced Features:

Peglers improved non-heating handwheel
This 'ever-cool' wheel is now fitted as standard on all Peglers steam valves. Pleasant to grip. Red enamel finish.

Coded for rapid identification
Colour-coded identity discs are fitted at the centre of handwheels, indicating valve pressure and temperature ratings, and B.S. number.

ENGINEERS!

Send now for your copy of Peglers new 1960 Catalogue

When writing please state name of your Company and position you occupy

Peglers range includes: Copper Alloy Globe, Check and Gate Valves, as well as Radiator Valves and Unions—all to B.S. requirements.

Peglers Limited
The name is the guarantee

PEGLERS LIMITED, (Dept EE) **BELMONT WORKS, DONCASTER**

London Office and Warehouse: PRESTEX HOUSE, MARSHALSEA ROAD, SE1

Also at 28 Thorp Street, Birmingham, 5

TGA. 57198

Human Element

Talks and Probabilities In the Car Crisis

Driven forward by the growing short time and outright redundancy in the motor firms, the economic committee of the Trade Union Congress and the leaders of the Confederation of Shipbuilding and Engineering Unions are hurrying to meetings, both between each other and between the Confederation and motor industry managements.

Mr. Jim Matthews, the National Union of General and Municipal Workers officer who is chairman of the CSEU, has expressed a general union fear when he says that the future expantion plans of the industry, in Wales, Scotland and Merseyside, will double its present capacity and he would like to know where the manufacturers expect to find the additional markets.

With the British Motor Corporation announcing short time working for another 20,000 of its employees there is now serious under employment in every major British car plant except Jaguar and Ford.

The Ford company's performance must attract admiration and some interested curiosity as to how it is done. Overtime may have largely been eliminated but there is still no short time working or redundancy. On commercial vehicles production is still going at full bore.

The Confederation's chairman has observed directly on this point that one of the benefits of a meeting between themselves and the employers would be that Sir Patrick Hennessy, the Ford chairman, would be able to tell the other car chiefs how to arrange the companys' working so as to avoid unemployment.

It is particularly fortunate from the work people's position that Ford's have proved the company able to hold out against recession the longest. Almost no other major car plant employs so high a proportion of the local people as does the vast Dagenham (Essex) Ford works with its integrated Briggs Motor Body works.

A man sacked in the Midlands should, by all accounts, find other—if not so well paid work—with much greater ease than the production line operative who found himself competing with others in the Dagenham area. Though for both men it should be pointed out that vacancies exist within travelling distance.

How Do You Behave At a Meeting?

If there is one thing of which people are certain in an uncertain world it is that, if the occasion arose, they would acquit themselves well at a meeting. If they happened to be the chairman—well, so much the better.

Among those who know, this is recognised as patent nonsense. Nothing is easier for the uninitiated to enter unprepared into the deceptively calm airs of the committee room and find that their points are just not appreciated, or even necessarily heard.

"How to Behave at a Meeting" is one of the subjects covered in the *Supervisors' Handbook and Diary*, issued by the Industrial Welfare Society. Last year the diary was sold out within six weeks of publication. The 1961 edition is now available.

Apart from a collection of facts and figures of value to supervisors in a variety of industries, the diary goes into such subjects as: How to write a report, What is personnel management, How to operate a suggestion scheme, Training within industry, and Examinations in management subjects.

A matter of importance to works foremen is the thoughtful provision by IWS of a cover which is grease and oil resistant and which can be washed.

Advance in Braille Means Thinner Volumes for Blind

Up until now a braille Bible has been contained in 72 volumes which when standing side by side would measure about 10 ft 6 in across. The new plastic dot printing process introduced by the Royal National Institute for the Blind will have the very considerable effect of reducing this dimension by a half.

Such is the implication behind the installation at the Institute of a new rotary press. Old style braille was printed on thick manilla paper with the dots formed by distorting the fibres. The new style publications will be printed on kraft paper of half the thickness, the dots being formed of pvc plastic. How this is done is explained in an article in our Design section.

Besides greatly reducing the bulk of volumes, the RNIB will be saving money by resorting to this process because it is faster and therefore cheaper. The result will be that their already vast outpourings will be increased, much to the satisfaction of their readers.

Development of the process has taken about ten years and Mr. Edward Pyke, technical officer at the RNIB, and the engineering firms who have contributed to the machine, are to be congratulated on persevering and bringing the process to perfection. Although electronic aids are being developed for the blind, they still prefer—as do sighted people—to read themselves rather than be read to.

Failure Courses At Bradford Institute

A course of six lectures on the causes and prevention of failures is to be given at the Bradford Institute of Technology, beginning in the middle of January.

Opening with a general lecture on types of failure, the course will go on to deal with fatigue and the types of failure which predominate in various branches of engineering.

£100 for Tyre Suggestions

Two awards, amounting to £110, have been made by the Goodyear Tyre and Rubber Company (Great Britain) through their suggestion scheme.

The first, a joint £70 award, was to a member of the company's engineering division and to one of the technical service division for their suggestion for avoiding waste in steel tyre building.

The second, £40, award, to another technical service employee, was for a proposed new design for tread edge trimmers. The suggestion is now in use at the Wolverhampton and Glasgow works.

Less Specialisation Among Engineers of the Future

It was natural for Professor Owen Saunders, F.R.S., in his presidential address to the Institution of Mechanical Engineers to look back to the years when scientists were looked upon with suspicion by practical engineers and when engineering graduates found some difficulty in getting the right jobs.

It is not a coincidence that both phenomena have disappeared today. When Professor Saunders left Cambridge in 1926 the suspicion and the difficulty about jobs both still existed. The major new industries—radio, electronics, aeronautics, synthetic fibres were infants alongside the old established openings for engineers in mining, shipbuilding or general engineering.

When Professor Saunders says that today the position is very different, largely because of what the scientist has done for the engineering industries there can be very little room in which to dispute the generalisation.

Listening to Professor Saunders could lead to the conclusion that the next generation of engineers may have more in common with such ancestors as George Stephenson than we enjoy at present. Their period of engineering, being much less developed, was a time for the all-rounder.

In the words of the Mechanical's President; "My own view is that the present age of specialisation in engineering is giving way to a realisation that there is more in common between the different branches than is at first apparent, that the present divisions of engineering are transient and likely to give way to a closer integration of the engineer's work.

"Areas of high specialisation always exist and are constantly changing, but they do not necessarily call for the best men once the pioneering is done, these being particularly needed for the broader tasks of guiding engineering progress along the right lines."

Professor Saunders is Professor of Mechanical Engineering at the Imperial College of Science and Technology and Dean of the City and Guilds College.

Swansea University College Development Appeal

£500,000 is a very small part indeed of all the money that has been and is being poured into the industrial redevelopment of South Wales.

But £500,000, when it becomes the target of an appeal assumes towering proportions. Over the next eight or nine years it is the intention of the University College of Swansea to double its student population. The College's contribution to the expansion of the nation's university facilities is therefore equal to the best being done elsewhere, and very heavy looked at as a burden on its present resources.

Less than forty years back the College opened with about a hundred students and one permanent building. By its fiftieth anniversary it will be a collegiate community, principally residential, and numbering more than 3,000 people. The Treasury has already approved the expenditure of between four and five million pounds in providing the splendid modern buildings that will take the place of the present accommodation.

There is a sound record of local generosity towards the College by local government and by industry. One of the two professors of Metallurgy was appointed after £100,000 had been given by Richard Thomas and Baldwins and the Steel Company of Wales. Among the total of 24 professors there are one each for civil, mechanical and electrical engineering.

For the completion of its ambitious—and necessary—plans, the College needs and merits the most generous public support.

Punctures and Pump Troubles, a Year of M1

The impression of the English as an early-to-rise and early-to-bed nation is strengthened by the Automobile Association's review of the first year of the London-Birmingham Motorway.

Of all the 13,500 breakdowns, 86 per cent took place between seven in the morning and nine in the evening.

The AA's report is in fact on the total number of breakdown calls answered from their motorway control centre near Newport Pagnall. An estimated five million vehicles used the motorway in the first twelve months, giving odds of 400 to one against any particular motorist suffering a breakdown.

Among those who did not make the journey at the first attempt, 1,406 called for assistance for wheel changes and punctures. The other main groups were not far behind—1,377 perhaps rather incautious drivers ran short of petrol or oil. Another 1,328 had electrical trouble. There were 1,268 in trouble with the petrol feed or pump and 985 had fan belt difficulties. Right at the end of the list came 79 stuck in mud on the road's shoulders. No one has been caught like this since April.

All these failures are not taken by the AA to mean that the British family car cannot take the conditions of being driven up the M1. Instead, concludes the Association, "the M1 will very quickly disclose any slight defect which has escaped routine maintenance."

While commercial vehicle operators have been swinging back to using the old A5, the road much of whose load has been taken by the motorway, the private motorist is evidently staying with M1—punctures, belt failures, and all.

Mile for mile, says the AA, the M1 is undoubtedly one of the safest roads in Britain. It compares more than favourably with similar roads in other countries.

After which is only remains to hope that the Government will take the brakes off a little and allow other motorways to be built in something like the amount and at the speed that is needed.

Helping Engineers Gain Independence

For those who have started a small private business in the country, the Rural Industries Bureau offers many services, including marketing, accounting, training, research and test facilities.

DREAMING of self-employment is a widespread pastime from which engineers are not exempt: most will have toyed with the idea of starting a small business of their own at one time or another. Some, like Sir George Dowty, pull it off, many more fail, but for the majority independence remains only a dream. The high mortality and chronic morbidity of small new businesses is a powerful deterrent.

Small organisms, whether in business or nature, are handicapped from the start. In nature, two methods have evolved to ensure the survival of a species: with higher animals the parent takes elaborate precautions to protect the young; but with the lower forms of life the offspring are simply launched in such fantastic profusion that some will have a statistical chance of survival even against the most overwhelming odds. Small businesses are generally launched under the latter system, crude and wasteful as it is. It need not be so.

A little-publicised organisation known by the misleading title of the Rural Industries Bureau has the determination, the skill, and some of the means to protect and aid young businesses. The Bureau was established as a State service in 1921 with the aim of assisting rural industries with technical advice and small loans. At that time rural industries were primarily concerned with traditional skills such as thatchery, wrought iron work, saddlery, basket work; and handicrafts such as pottery and weaving. But the mechanisation of farming soon introduced a new engineering element among the traditional skills of the village. The repair of farm implements became an important activity and brought such diverse engineering skills as welding fabrication, pipe fitting, and the repair of hydraulic machinery to predominantly agricultural areas.

UNDER TWENTY PERSONS

Gradually the balance of the Bureau's clients shifted and it became logical to stretch the original terms of reference sufficiently to permit aid to industries which were located in small county towns. In true British fashion the Bureau's name remained unchanged, although aid is now given to any industry employing less than twenty persons located in a village or county town with populations under 10,000. Today the products of rural industries range from the Cushioncraft ground-effect machine to X-ray diffraction cameras.

Unless someone is in an exceptionally fortunate situation, his new business venture will have to start in a very small way. By implication, the number of persons employed will be well under 20 at least during the initial years.

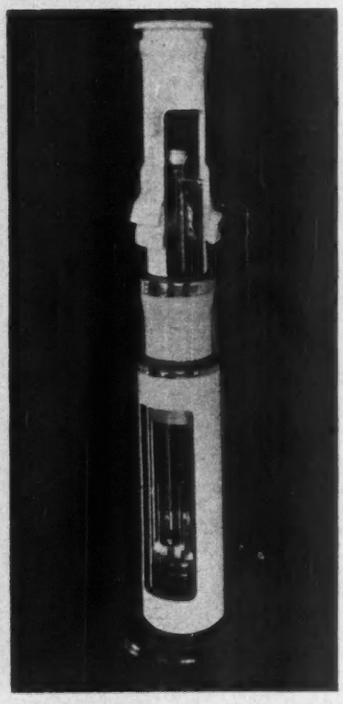
Operating from a small town or village may be just the thing for those whose daydream includes long walks in country lanes, but the economic consequences of siting away from the industrial centres must be carefully examined. The Bureau's activity is now directed at overcoming any handicaps that arise from location, in addition to offering help and services needed by any small business.

LINES OF COMMUNICATION

Apart from the skill and initiative of its leader, the essence of any business is contained in communications, transport, manpower, power, and equipment; all of which are functions of the chosen site.

For certain industries the excellence of communication is the *sine qua non* and it matters little how much manpower or equipment may cost. A typical example is the garment trade where the "feel" for trends, the quick response to changes in styling, the ability to snatch an order and deliver the goods in a hurry are all-important. This type of business tends to concentrate in selected areas of the world's fashion capitals and it would be hopeless to attempt to relocate in a village. But in engineering the pressure on communications is less acute, and in a small, relatively densely populated and highly civilised country such as the United Kingdom the channels of communication reaching certain rural areas may be adequate, even though more costly.

Lack of personal meetings and interviews, and losing touch with the industry is a more important handicap that would be felt both in the search for new products and the search for new outlets for established products. In the light of this need, the Bureau maintains a market intelligence service which keeps an eye on opportunities created by economic changes, and cultivates connections with buyers both at home and abroad. To help sell the products of industries under the care of the Bureau, the information and exhibition section has a permanent staff of four, including a photographer and writer, and gives advice on presentation and advertising.



Product of a rural industry: C. and F. Parker Limited specialise in sectioning machinery for exhibitions and instruction.

Transportation in a country such as Britain may be considerably better in carefully selected rural areas than in the great industrial centres. The average roadspeed may be as low as 4 miles per hour in a congested city, but in rural areas an average speed of 15 to 30 miles per hour (depending on the driver) can be counted on. In comparing city and rural road distances there is thus a scaling factor of over five that has to be taken into account. Although the frequency of rail services will certainly be less than in London, careful selection of the site can eliminate any serious handicap.

The big problem of rural engineering industries is manpower. In fact, the shortage of skilled labour in rural areas is a sociological problem going far beyond the simple fact that industrial labour is missing from the countryside. Not only skilled labour but young people with intelligence and initiative are missing from the villages and small towns owing to lack of opportunities and the attraction of big cities for the enterprising mind. The removal of bright young people follows a vicious circle, each wave of emigrants impoverishing rural life and making it less and less attractive. The tragedy of the process is that removal of intelligent youth robs not only the village of its life, but also the youth of its opportunities: their presence in the cities will go unnoticed, while in a lively village their personality is much more likely to develop and shine.

REVERSE URBANISATION

The industrial labour problem in rural areas cannot be solved solely by local training: a whole trend must be reversed. Even assuming that suitable men are found on the farms and in village shops and are trained in the necessary skills, these men will not remain in the village for long unless special attractions are provided. Real wages comparable to those paid in the cities for similar work appear to be the minimum requirement. This condition, incidentally, means that a village industry cannot gain competitive advantage through reduced labour cost in cases where the job requires a true skill. (The situation with unskilled or semi-skilled labour may be quite different.) But wages are not all: the rural or small-town way of life must be successfully sold to the employees if high labour turnover is to be avoided.

Selling is easiest where there is a desire to buy, and the desire for rural life is, paradoxically, strongest among sections of the urban population. The solution to a rural engineering firm's labour problems may well lie in recruiting skilled men from among city dwellers who are fed-up with their way of life and dream of settling in the country. If rural industrialisation became sufficiently widespread, the present trend of urban growth could be reversed, and the more balanced distribution of population found in Switzerland, Germany and the Austrian Vorarlberg achieved in the United Kingdom.

The Bureau in the meantime concentrates on local training as a stop-gap measure. A team of 15 engineering instructors are travelling up and down the country, giving individual or group training, where there is sufficient demand, to skilled workers who wish to develop and extend their skills. In the period 1959 to 1960 over 4,000 instructional visits were made to teach gas welding, arc welding and other techniques, and about 150 people attended short courses in aspects of farm machinery repair. The result of the Bureau's work is that the shortage of workers in the lower skills can be overcome, provided there is sufficient demand to ensure steady employment. Highly skilled workers may still have to be imported from the industrial towns, but occasionally tool and instrument makers, diamond drillers and other skilled workers have been found in country districts.

POWER AND SITE

Electricity is within easy reach of almost any point in the British Isles, although the cost may vary. For an industry that uses significant amounts of electricity the site must be selected so as to ensure low costs. In one instance the Bureau's experts found that it was cheaper to install a diesel generating-set in a wheelwright's shop than to tap a transmission line only 300 yards from the premises. But normally it would be unwise to select a site where low-

tension electricity is not already in the vicinity.

Shop equipment, which includes site and building, was the last item listed as forming the essence of a business. The cost of sites and buildings may be considerably lower in rural areas than in the industrial centres, but modifications may be necessary to make an existing building suitable for industrial occupancy conforming to national and local regulations.

The Bureau's technical staff is competent to give advice both on the extension and modification of buildings, and offer advice on shop layout and machinery.

SECOND HAND EQUIPMENT

To reduce the initial investment it may be desirable to equip a shop with secondhand machinery. If this is attempted, the rural site becomes a definite handicap and may involve numerous costly trips of inspection. Again the Bureau's staff may in some instances devote time to the business of finding and vetting specialised secondhand equipment. The advisory service also undertake the testing of new plant and equipment in its experimental workshops. An example is the thorough testing of a new type of lightweight transformer for arc-welding purposes that was believed to be suitable for the load characteristics of rural industries. The test revealed a number of faults in the electrical insulation and connections, which the manufacturer has since corrected in consultation with the Bureau.

It may be concluded that with the exception of obtaining skilled manpower, the choice of a rural site need not reduce the chances of success for a new enterprise, provided that the site is selected with care. But on the credit side of the balance sheet are the resources of the Rural Industries Bureau, which are available virtually for the asking. In addition to the services already mentioned, such as marketing, assistance in site selection, design of shop layout, the purchase of equipment and training of apprentices, the Bureau offers help in product research, product design, method study, costing, accounting, stock control and other administrative needs.

RESEARCH FOR SMALL SHOPS

Since small businesses cannot in general afford extensive experimental facilities, the Bureau maintain an experimental workshop where new products can be developed and tested. Much of the work at present is concerned with agricultural machinery, but some interesting engineering products have also been developed. Fabricated stainless-steel boat fittings are being tried to replace the galvanised mild iron used at present.

An original development is the foam cored glass-fibre boat which will float fully submerged without the use of buoyancy bags or compartments. The hull is constructed of an approximately one-inch thick layer of pvc foam sandwiched between two layers of glass reinforced epoxide resin. Work is also in progress on the development of plastic boat fenders, and the repair of glass-fibre boat hulls and car bodies.

The workshop is well equipped to perform physical tests on raw materials or products, with machinery that would otherwise not be available to a small engineering firm. Prototypes of special jigs and tools have been made in connection with the work study programme of the bureau.

To overcome the adverse economy of scale a small shop must operate at high efficiency if producing a standard line of products. Since 1959 the Bureau have offered a work study service to find the best production methods that would fit the skills and equipment of any particular firm. The study's scope includes not only flow studies and production methods, but also other modern methods of improving plant efficiency.

In general the standard of business management in small firms is much lower than the standard of production. Often the office staff, recruited locally, will be quite unskilled in the higher arts of office management and the methods of record keeping and accounting are haphazard or inefficient. The Bureau's business management service will give advice on suitable systems of accounting, invoicing, stock record keeping and the proper documentation of shipments to home or overseas customers. Short courses are arranged in accounting, costing and estimating in order to raise the standard of office work.

The shortage of capital is an almost chronic problem with small businesses. One reason is lack of experience in raising credit through the normal financial channels, and the Bureau have arranged courses on this subject. In addition, some money is available from the Rural Industries Loan Fund for the purchase of buildings or equipment. A total of over £22,000 was made available through the fund for equipment purchases in the 1959-60 period.

The Bureau's marketing experts give advice on a variety of problems connected with the movement of products. These services include advice on advertising, exports, market trends, and even problems in connection with patent applications and patent infringement. In addition to advice on specific problems, a number of publications have been prepared by the staff to give background knowledge. These books, costing under 7*s* 6*d*, include *Business Methods*, *Marketing*, and *Export Made Easy*, all available from the Bureau's office at 35 Camp Road, London, SW19.

NO MORE COMMUTING

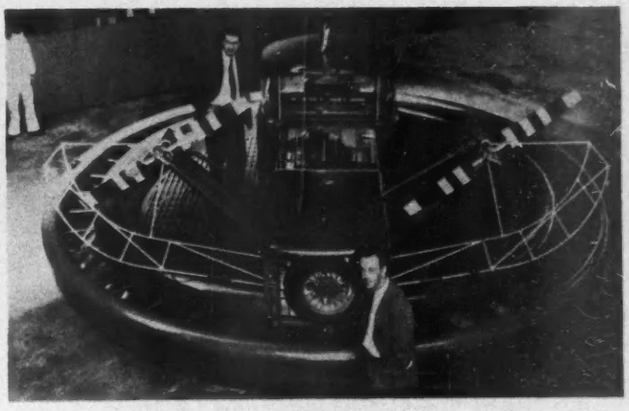
It appears that with the backing of the Rural Industries Bureau the most difficult problems of striking out in a new business venture without prior experience can be overcome. All that is necessary to make a start is the determination to become independent, and possession of a saleable idea, product or service. The next step then is raising capital, which should not be impossible if the idea is " saleable," and the venture is on its way.

The engineering products of rural industries registered with the Bureau show an amazing variety. At the exhibition *Made in the Country*, held at the Ceylon Tea Centre in London from 20 to 29 July this year, some of the more unusual products were shown to a wide public.

Jim Russel's racing car firm employing six men in Norfolk showed the Ruskat racing kart costing £85. Granta Folding Boats, a Cambridgeshire firm employing 16 people, exhibited a light-weight outboard motor designed for canoes. Several of the over 400 boatbuilders were represented, while sporting goods included decoys, arrows, targets, tackle boxes and fishing flies. Beaumaris Instrument Company employ ten people to supply X-ray diffraction cameras to universities around the world from a small shop in Anglesey, North Wales. C. and F Parker Limited, specialise in sectioning machinery for exhibitions and instruction. A recent contract came from Dowty Hydraulics for sectioned models of the " Duke " hydraulic pit-prop. motor and aircraft manufacturers are frequent customers of this 12 man Gloucestershire firm.

S. and G. Sergent employ ten people near Norwich to make woodturning lathes which have been exported to over ten countries. Allbon-Saunders make model aeroplane engines; B. S. Palmer and Company Limited, steering modifications to Triumph sports cars, and hydraulic bending tools, while Olicana Products sell their low-cost scooter and motor-cycle windshields from a shop employing only five workers.

Jim Russell's six men in Norfolk turn out a line of racing karts.



Ambitious and unusual fruit of rural industry is the Britten-Norman Cushioncraft.

Some of the rural products are truly surprising. Britten-Norman's Cushioncraft ground-effect machine made history recently by competing with the Hovercraft of a much larger organisation (ENGNG., 1 July, '60, p. 14). Competition from the giant rubber companies notwithstanding, a small shop can make a living by producing —and exporting—tennis balls. Similarly, jobbing in deep-drawn press work, die sinking, the making of extrusion moulds and pressure castings, radar equipment, special electric motors and transformers, prefabricated framed buildings and roof trusses, plastic racing car and truck bodies, profile projectors and optical tools, pumps, ploughing equipment, fire alarms, hot plates, water tanks, and commercial glass-houses can form the economic basis for rural firms employing less than 20 people, in addition to the more conventional skills of boat-building, ornamental iron work and the repair of machinery.

For the man with initiative and willingness to take some risk there are plenty of opportunities. It is said that the first start, the first contract, the first year, and the first million are the most difficult steps in the history of a new business. With the help of the Rural Industries Bureau the statistical chance of successfully completing the first step and the first contract—both prerequisites to making the first million—can be improved enormously.

Sandstone Dictates Choice of Gravity Dam

Though sited in a narrow valley where an arch dam was the obvious solution, because of the rock formation a gravity dam has been built at Warragamba. The importance of separating the apron from the dam was proved by slice model analysis.

A MASS concrete gravity type dam of 450 ft overall height and requiring 1,610,000 cu. yd of concrete is nearing completion on the Warragamba River, some 50 miles west from Sydney. Although a hydro-electric plant of 50 MW capacity has been built in, the dam, constructed by the Sydney Metropolitan Water Sewerage and Drainage Board with its own forces, is primarily intended to augment the water supply to the Sydney area, now serving a population of over two million.

The cycle of droughts makes water supply in the Sydney area a much more critical civic and industrial problem than where the climate ensures a more regular replenishment of water supplies. London, for instance, has a reserve of only 4,000 gallons per head of population and New York 38,000 gallons, while Sydney requires 96,000 gallons.

The worst recorded drought with which Sydney has as yet had to contend lasted from 1934-1942, i.e. eight years. To avoid severe restrictions during any subsequent similar drought, the storage must at least be such that, if the drought were to commence when all the Board's dams were full, they would be able to sustain the demand over its duration and have 12 months' reserve left at the end. The Board's existing reservoirs at Cataract, Cordeaux, Avon, Nepean and Woronora, were inadequate to sustain such a demand and hence the need arose for the Warragamba dam. The Warragamba river has a catchment area of 3,383 sq. miles and an average annual flow of 240,000 million gallons.

Diamond drilling investigations were made of a number of possible sites before the final one for the new dam was chosen. At this site there was a layer of sand and gravel 10 to 20 ft thick above a bed of Narrabeen sandstone 150 ft thick.

While the arch type is more normal for a high dam in a narrow valley, doubt was felt about the ability of the sandstone in the abutments to take the heavy thrusts. This sandstone is intersected by a system of vertical joints and, on the western abutment, is underlain by a geological fault that further reduced its resistance. This condition mainly led to the selection of a straight gravity dam. Early consideration had been given to side spillways, a spillway excavated in a saddle, and other types, but with a straight gravity dam an overshot spillway (being the most economical) was adopted. This required a spillway apron over 300 ft long and 300 ft wide to protect the foundations of the dam from erosion during floods of up to 450,000 cusecs. Because of the shape of the river valley downstream and the confluence of another river carrying high flood flows, side walls on the apron 135 ft high were required to provide some freeboard above the level of the tailwater during floods.

DIVERSION WORKS

The maximum known flood occurred in 1867 when the river flow was an estimated 450,000 cusecs. Due to the excessive cost of constructing a diversion tunnel to cope with such a flood, it was decided to accept likelihood of the works area being flooded an average of 3·5 times a year and provide for diversions of river flows up to 3,600 cusecs by constructing under the eastern bank a 1,800 ft long tunnel 18 ft wide by 14 ft high, completely concrete lined except for the downstream 300 ft of roof.

The actual dam site was separated from the river by two cofferdams. The upstream cofferdam 46 ft high was constructed of gabions (rock-filled baskets) as protection on both faces. The centre hearting was quarry refuse of below 4 in diameter. A water seal was made by driving steel sheet piling through the hearting into a prepared clay-filled trench previously cut into the rock. The downstream cofferdam, 33 ft high, was of rockfill, constructed with bulldozer and sealed by grouting with cement and sawdust.

As the extensive catchment makes the Warragamba River subject to sudden flooding, flood-warning stations were established and river levels were transmitted by radio to a control office overlooking the dam site.

The river bed consisted of up to 20 ft of gravel and sand overlying the sandstone. Where not accessible by road, excavated material was removed by means of the cableways with 16 ton skips. Generally the excavated material was removed by 2 to 2½ cu. yd shovels, off-highway vehicles and tournapull buggies. Successive floods also deposited sand and forest debris. The total excavation was 1,484,600 cu. yd, including 301,900 cu. yd of flood-borne debris.

Main Dimensions and Data

Site selected: 1946—Dam complete: 1960
Volume of stored water at full supply level: 452,500 million gallons (1,665,000 acre-ft)
Area of lake: 29 sq. miles
Maximum length of lake: 32½ miles
Area of catchment: 3,383 sq. miles
Average annual rainfall: 33 in
Average annual inflow: 240,000 million gallons
Outlets: 4 to 84 in dia. outlets for water supply
Electric power: 14 ft dia. penstock to 50 MW hydro-electric station located behind apron training wall
Maximum height of concrete: 450 ft
Volume of concrete: 1,610,000 cu. yd
Maximum depth of stored water: 340 ft
Length at crest: 1,150 ft
Minimum width of wall near crest: 28 ft
Width of wall at base: 340 ft
Full supply level (above sea level): 383 ft
Roadway level (above sea level): 409 ft
Length of spillway crest: 310 ft
Crest gates: 4 radial gates each 40 ft long by 40 ft high, 1 drum gate 90 ft long by 25 ft high
Design flood: 350,000 cusecs over the spillway with ability to take 450,000 cusecs with reduced freeboard

The steep sided valley of the Warragamba.

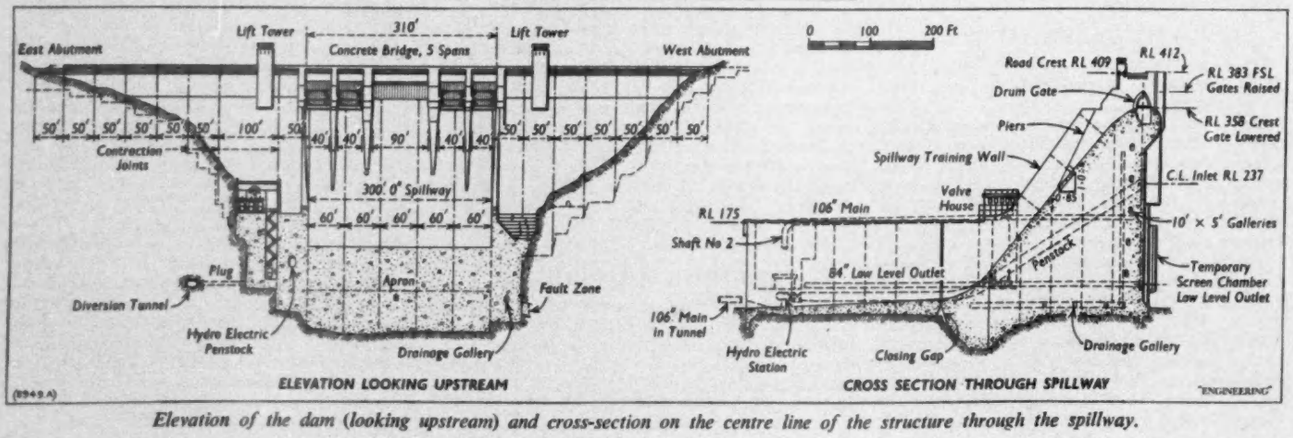
DESIGN ANALYSIS

In addition to the usual examination of stresses for gravity sections three analyses were made:—

Shear Twist Analysis.—This was a three dimensional linear stress analysis taking into account horizontal beam and shear-twist action in addition to the cantilever action. A 10 : 1 concrete-to-rock modular ratio was allowed for. This analysis initially indicated high tensile stresses near the abutments and near the centre of the spillway, mainly due to the beam action. Further calculations were made with vertical joints which divide the dam into independent cantilevers and permit pure cantilever action until the water level reaches three-quarters of its full height, after which these joints are grouted and the dam acts as a unit. Tensile stresses were reduced and load and shear in the abutments were also reduced by providing vertical joints.

Lattice Analogy.—This was a non-linear analysis of a cantilever section only, taking into account various ratios up to 10 : 1 between the Young's moduli of concrete and rock. Considerable departures from linear distrbutions of stress were indicated near the foundation level in both the concrete and rock by this method. High stress concentrations occurred near the upstream and downstream faces, and it was decided to further investigate these stresses by means of slice models.

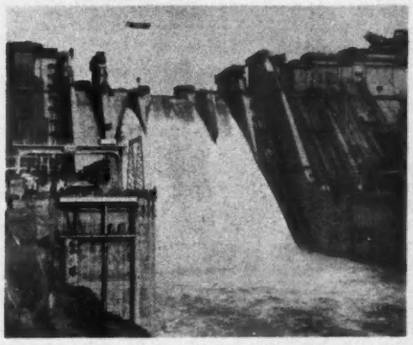
Models.—Rubber slice models were made from solid and sponge rubber representing concrete and rock respectively. The purpose was to



Elevation of the dam (looking upstream) and cross-section on the centre line of the structure through the spillway.

examine stresses at the junction of the apron and the dam, previous analyses not having given sufficient information about this problem. These models indicated a stress concentration at the junction of approximately 1,200 lb per sq. in and also showed that a large proportion of the horizontal thrust from the dam was transferred to the concrete apron rather than to the thrust trench. The introduction of a 15 ft gap between the dam and apron reduced the concentration of stress and the maximum thrust in the apron. Though possible movements of the apron and underlying rock were a problem, the use of a gap was considered more desirable than joining the apron to the dam.

A lage slice model was also made from brass sheet and bakelite sheet, representing the concrete and rock respectively. It was assembled and tested at Sydney University. Electric resistance strain gauges and electronic measuring



The nearly completed dam.

equipment were used to find stresses. The results generally indicated the necessity of a gap at the toe of the dam, thus confirming the rubber model work.

The foundation rock, mainly Narrabeen sandstone with shale seams, dips 5° (approx.) downstream. An extensive faulted zone exists under the western abutment and there are subisidary shear zones elsewhere. The mean compressive strength of the sandstone is 4,000 lb per sq. in and the values of modulus of elasticity (secant) for the rock ranged from an average of 230,000 to 460,000 lb per sq. in, depending on conditions of test, for sideritic and kaolinitic cemented sandstone to 1,000,000 lb per sq. in for shale.

The modular ratio used for shear twist analysis was 10 : 1 and for the most recent model work (deflections in apron) 15 : 1. These high modular ratios raised many design and construction problems.

The low modulus of the rock compared with the concrete results in a concentration of stress at the extreme downstream toe where the load is transferred to the rock. To lower the stress there, a thrust trench was excavated into the rock. The design required a depth of 50 ft of sound rock as a protection against sliding in the spillway section, with progressively less in the abutments.

FOUNDATION GROUTING

In addition to random jointing in the rock, large horizontal fracture zones exist, occurring to very great depths. To obtain relative watertightness the rock was stage-grouted in the first place on a 40 ft grid to a depth of 80 ft below the foundation, the general purpose being to fill the main water passages occurring under the dam. A 10 ft grid of 1¾ in diameter holes was then grouted to a depth of 50 ft under the dam and 30 ft under the abutments. Grouting operations were conducted in groups of up to 10 holes.

The efficiency of the grouting was determined by drilling pairs of holes 5 ft apart, and testing each with water under 10 lb per sq. in pressure. The criteria for acceptance was that there should be no connection between holes and that the leakage from either hole should not exceed 100 gallons per hour. Three applications were the minimum applied to each hole. The reduction in grout-take was also accepted as a measure of the effectiveness of the operation.

The main barrier to the percolation of water directly under the dam foundations is a high pressure grout curtain located under the dam near the upstream face. An intermediate pressure curtain has been drilled in the first place through the rock under the dam to intersect the main high pressure curtain at a depth of 75 ft below the concrete. The high pressure curtain was then drilled from a gallery located in the concrete close to the rock foundation. The depth of this curtain is 180 ft in the main spillway section but decreases under the abutments.

Undesirable temperature effects were avoided at the dam by using low heat cement, keeping the cement content to 3·5 bags per cu. yd, adding ice to the mix to lower the placing temperature, embedding coils of piping and circulating water during pouring and for the next few months thereafter, and constructing the dam as a series of prisms of 50 ft by 50 ft nominal size (ranging to 60 ft by 70 ft in the spillway section). The addition of ice to the concrete mix, to prevent excessive cracking following hydration, was applied at Warragamba dam for the first time in Australia.

To bond the series of blocks, keys were cast in the vertical faces, and, to form one continuous wall, cement grout under pressure was pumped into the spaces between blocks. To ensure thorough grouting, the joints were zoned off in vertical intervals of 50 ft by surrounding with a copper seal flexible enough to allow relative movements

The dam is the highest in the Southern Hemisphere.

between blocks and at the same time strong enough to contain the grout.

The low-heat cement, of which 270,000 tons were required for the construction of the dam, was transported by lorries to Warragamba in 3 ton containers each equipped with an air-slide for unloading into the receiving hopper. It was then pumped either to storage silos or direct to the 60 ton capacity service hopper in the central mixing tower.

Concrete was centrally mixed in a tower above the south-east abutment to which aggregates and cement, as previously described, were conveyed to service bins at the top level, then to weighing hoppers below. From the hoppers the weighed materials, plus water and ice, were fed through a swivelling chute to each of four mixers in turn. These tilting mixers discharged into a 10 cu yd. wet-batch hopper, then into 8 cu. yd concrete buckets which were moved by rail truck and diesel locomotive to a position under the 18 ton cableways which radially command the site, except for the apron area which is covered by a 10 ton cableway.

Long steel panel forms were used for the upstream faces, but, for internal faces, the concrete was placed against plywood panel forms with an oregon framework. Steel cantilever profiles were used except near the rock. Before the placing of concrete (in 5 ft lifts) the surface was sandblasted, and heavy duty pneumatic vibrators were used both for spreading and consolidation. Placing completed, the concrete was covered with hessian and cured with water sprays for 21 days.

The main control was based on the mean compressive strength at 28 days at 12 in by 6 in cylinders which had to be not less than 2,100 lb per sq. in plus twice the standard deviation of the results.

OUTLET WORKS

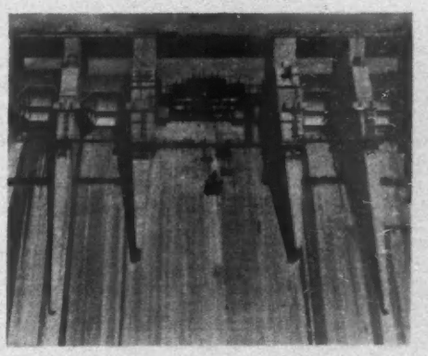
Located at about the centre of the crest is a 310 ft wide spillway equipped with a 90 ft by 25 ft drum gate flanked on each side by two 40 ft by 40 ft radial gates, all made by Glenfield and Kennedy Limited of Kilmarnock, Scotland. The maximum flood allowed for was 450,000 cusecs (estimated to be a possibility once in 1,000 years).

Four 84 in diameter outlets convey the water through the dam to the downstream face where, at the valve house, they converge into two mains (each 106 in diameter) as far as the Nepean River crossing, whence three pipelines (each 84 in diameter) will convey the water to Prospect Reservoir.

To date one 84 in steel pipeline has been constructed from the Nepean River Crossing to Prospect Reservoir. It is continuously welded in lengths up to 550 ft, with an expansion joint in the centre allowing a maximum expansion of 3 in in each section; anchor blocks are located every 560 ft. The pipeline is internally protected with 1½ in to 2 in cement lining and externally with a zinc preparation. The pipes are supported at 45 ft intervals by vertical rocker plates which allow for expansion on concrete sills.

The whole of the storage capacity of Warragamba Dam is not anticipated to be required until 1980, by which time it is expected that the population served by the Board will reach 2,600,000. In the meantime an agreement has been reached with the Electricity Commission of New South Wales for the surplus water to be utilised in generating electric power. Accordingly a 50 MW hydro-electric power station has been constructed at the downstream end of the east bank training wall. When operating at full capacity this station draws water from behind the dam through a 14 ft diameter pipe at the rate of 2,300 cusecs.

This article is compiled from material supplied by the Sydney Metropolitan Water, Sewerage and Drainage Board. The Board's engineer-in-chief is Mr. T. B. Nicol, C.B.E., B.E., M.I.C.E.



The four radial gates and the 90 ft wide drum gate in course of erection. They were all supplied by Glenfield and Kennedy.

A New Approach to Strength of Materials

Three simple concepts serve to unify the mechanics of deformable solids. Recognition of this unity leads to a better understanding of the subject and hence relieves the pressure on students' memories.

By Professor R. E. D. Bishop, M.A., Ph.D., D.Sc.(Eng.), A.M.I.Mech.E.

Department of Mechanical Engineering, University College, London

THERE can be no doubt that Strength of Materials is a subject of great importance in engineering education. In mechanical engineering, at least, it is among those subjects which are steadily increasing in absolute importance, but to which less and less time can be devoted by teachers.

This state of affairs arises because fresh matter continually intrudes into the engineering curriculum. The upshot is that the teacher must constantly be casting about for topics which can decently be left out; otherwise his classes are going to suffer. Perhaps all lecture notes should be written in a special ink which tends to vanish after, say, four years.

In this process of selection, lecturers have not been helped very much by the writers of textbooks. A writer feels, not unnaturally, that he must include all the topics in current vogue because his book may not be required merely for teaching purposes, but also as a work of reference. Writers have not felt it their business to challenge the current methods of setting out their subject.

The result is a large number of books which bear some resemblance to Isabella Beeton's treatise. That is to say, the material is unassailable in its quality though it seems to be set out rather like a series of recipes. In particular, one gets the impression that new material inevitably demands new chapters. Since the war, for instance, it has become necessary to tack on a bit about plasticity. While these books seem not to give the whole picture without calling for more work than syllabuses currently permit, there is no doubt that they will continue to command the attention of stress analysts and others whose work requires study in depth.

THREE CONDITIONS

This criticism is all very well—but what can be done about it? Plenty. Suppose, as in any problem of Engineering, we define a system for the purposes of analysis by drawing a boundary around it. The mechanics of deformable bodies —which includes soils, steel, cement, and so on—now demands conformity with three basic requirements:

(1) *The Condition of Equilibrium.* The forces acting on any system at rest (or in accelerating motion if inertia forces are included) must meet the equilibrium conditions set in analytical mechanics. This requirement applies not only to any system but to any portion of a system, however it is selected. This is a problem of applied mathematics.

(2) *The Condition of Compatibility.* When a system distorts under the action of applied forces, it can only do so—assuming that it does not rupture—in such a way that all the portions into which it may be imagined to be divided continue to fit together. This is a matter of geometry.

(3) *The Environment-Strain Conditions.* When a piece of material is subjected to environmental influences such as applied loading or temperature changes, the manner in which it distorts must be specified mathematically for the purposes of analysis. And every portion of a system, however it is selected, must distort in conformity with the appropriate specification. In the last analysis, this is a matter of physics.

The engineer's task is to make practical use of these three principles; a measure of his merit as an engineer is his ability to do this *adequately* with the least complication in the mathematical sense.

If an engineer has a clear understanding of these three simple concepts, then he has a bare minimum of equipment so far as the applied mechanics of deformable solids is concerned. Yet how many books in common use stress this? A proper grasp of the *unity* of the theory of deformable solids relieves the pressure on students' memories and helps their understanding.

UNITY AND DETAIL RECONCILED

This fact has been realised for a long time. It has also formed the basis of a few lecture courses in this country. The reason why it has not been exploited in textbooks—and, hence, widely in universities—is presumably that, if adopted, it imposes a form of presentation which virtually ensures a more ruthless rejection of details than has been demanded before. The purpose of this article is to review a book which deals with Strength of Materials in this general way—and manages to do so without losing sight of practical matters of engineering significance.

The book in question is entitled *An Introduction to the Mechanics of Solids* (McGraw-Hill, New York and London, 55*s*). It is written by seven members of the Department of Mechanical Engineering in the Massachusetts Institute of Technology and its editors are Professors S. H. Crandall and N. C. Dahl. In my opinion, the result of their labour is strikingly good—though it is by no means the last word. It makes an excellent introduction for students in their first year. The general layout of the book is of some interest and it therefore seems worthwhile, briefly, to run over it.

The first portion, comprising three chapters, deals with statics. This section is well written and treats such subjects as sixth form statics, the three principles enumerated above, the separation of conditions (1) and (2) in the approximation known as " static determinancy," shear force and bending moment, and so on.

STRESS AND STRAIN ANALYSIS

Next comes an excellent chapter on stress and strain analysis. The Mohr circle is given a thorough airing and no effort is made to evade such matters as three-dimensional stress and strain systems, or polar and spherical coordinates. Such is the standard of the writing, however, that this material is by no means difficult to read. I can say so with the conviction of one who has tried the book out with a couple of undergraduate classes—one on the book's home ground in MIT, and one in University College, London.

The following chapter (5) is, perhaps, the core of the book. It must have been very difficult to put together and, although it does not meet all possible criticism, it can properly be described as a magnificent piece of technical writing. Its title is " Stress-Strain-Temperature Relations" and its purpose is to cover item (3) of the three listed above. One attractive feature of this chapter is that its writer is not afraid to say where we lack knowledge and further research is needed. It is a pity to give undergraduates the impression that the subjects they are asked to study are all cut-and-dried.

Having said that this chapter is a minor masterpiece and at the risk of being thought to carp, I want to draw attention to one or two of its shortcomings. There are some real difficulties of presentation here. First of all, it seems to be essentially difficult to explain plastic stress-strain relations in general terms in a first course in Strength of Materials; this weakness is hardly to be laid at the writer's door, and he does make a valiant effort to present the matter simply. The same might be said of anisotropic elasticity. The sections concerned therefore make rather more difficult reading for a first-year student and some teachers will prefer to use them as interesting general guides rather than as objects of close scrutiny. Aside from these difficulties of presentation, I should have liked to see a somewhat fuller treatment of fatigue phenomena. Again, it seems a pity that there is no mention of concrete or of soils at this stage.

THEORETICAL INSIGHT

Having laid a firm foundation of stress analysis, strain analysis and the way in which stresses and strains may be related, the authors now set to work on particular types of system, *carrying this introductory theory along with them.* In brief, they discuss torsion, stresses due to bending in beams, deflections due to bending and, finally, stability. These final chapters are very well written and give an unusual insight into the problems concerned. The job is done properly. For instance, " deflections due to bending " includes a brief discussion of the nature of limit analysis, while " buckling " includes short notes on practical instances of instability and even the mechanisms of " necking" and of plastic buckling are mentioned.

Turning now to a couple of major omissions and remembering that this is an introductory text, we may first note the absence of any discussion of energy methods. Here I must confess that I am in something of a quandary. On the one hand, energy methods are undoubtedly very useful. On the other, energy methods seem sometimes to be presented appallingly badly in textbooks. On the whole, I am inclined to agree that energy methods should be reserved for rather more advanced studies in Strength of Materials than those envisaged in the present book. Then the powerful (though subtle) method of virtual work can be tackled at the same time.

The second omission seems regrettable though not unexpected; it is that of inertia forces. The writers have written an adult introductory textbook and it seems a pity that they have let slip the opportunity to dispel some of the fear with which students tackle dynamics.

In the matter of examples, the book is quite outstanding. They are plentiful and mostly well thought out. They are also much to the point in some instances; one problem, for example, contains nothing less than the proof that the sign convention of the Mohr circle used in the text is, in fact, a consistent one. It is typical of this book that stresses in reinforced concrete beams are dealt with only in four problems—and even this brief encounter includes the principle behind prestressing. The point is not that the student will find out all that he may need to know in his professional career about reinforced concrete, needless to say. My own view is that laboratory work is needed as well.

One rather aggravating feature of the book is that only a relatively small selection of answers is given. Is the object to prevent students from having a peep at the correct answers? If so, the editors do not credit their readers with much maturity of outlook in this respect, although they obviously (and rightly) do in others.

To sum up, this book is an excellent one by any standards for introducing Strength of Materials. It is an *important* one because it has a layout which is likely to become widely adopted. We can safely risk our bottom dollars on the proposition that it is only a matter of time now before others appear of the same type.

Compact Integration

EURATOM's spearhead into the technical and political aspects of nuclear energy is producing beneficial results for the members of the European Atomic Energy Community. The technical achievements depend largely on the extent of the cooperation with countries with more experience of nuclear problems: the Community is still well behind the United States, the United Kingdom and the USSR in the rapidly expanding sphere of nuclear technology. Also, Euratom's progress during the next few years will depend extensively on the amount that can be learned from these more advanced nuclear countries. Euratom is a driving force for economic integration within the European Community, together with the European Coal and Steel Community and the European Economic Community. Since Europe cannot be wholly unified by the private efforts of the six Community countries, an important feature of the Paris and Rome Treaties is that membership is open to any European State though with certain reservations.

Agreements with Third Countries

Three agreements for cooperation have been signed between Euratom and non-member countries: with the United States, the United Kingdom and Canada, which are of extreme importance to Euratom in these early days. Taken together, the three agreements, and the Dragon and Halden agreements, put Euratom's research programme on a far wider basis than would otherwise be possible, since they enable Euratom to participate in various streams of reactor development, any one of which may provide the key to low-cost nuclear power giving a hard fight to the conventional power competitors.

United States-Euratom Agreement

The United States-Euratom agreement was signed on 8 November, 1958. Monsieur Etienne Hirsch, Euratom's President, described the agreement: " the first aim was a political one . . . to strengthen, by a combined effort, the unity of Europe and the ties between this new European Community and the US. The second aim was an economic one; it was to add to the reactor experience already gained in the United States the experience of full-scale construction in Europe, where the cost of conventional fuel is higher. This effort was to be accompanied by a major research and development programme. . . ." The agreement is exclusively concerned with the peaceful use of nuclear energy, and contains four main undertakings.

(1) Power Programme

The agreement covers a joint $350 million programme for the construction of nuclear power stations in the Community equipped with reactors on which research and development in the USA is well advanced. Of the $350 million, $215 million is to be provided by enterprises in the Community and up to $135 million by the United States Government in the form of long-term credits to Euratom to be reloaned to enterprises. The contract for this loan was concluded between Euratom and the Exim Bank in August, 1959. It was intended that power stations totalling about 1,000 MW installed capacity should be set up under the programme by 1965, but the fuel surplus in Europe has acted as a strong discouragement to its fulfilment. In the event, only two plants, totalling around 400 MW capacity can yet be regarded as firm projects; a 150 MW reactor which may later be increased to 230 MW, to be in operation by 1963 in Italy and constructed by the SENN company; and the Société d'Energie Nucléaire Franco-Belge de la Centrale des Ardennes (SENA) station, Euratom's first " joint project," on the Franco-Belgian frontier near Givet.

(2) Development Projects

Euratom and the United States are each to contribute $50 million over a five-year period (and probably the same sum over a second five-year period) to a joint research and development programme which includes improvement of boiling-water reactors, plutonium recycling, the study of plutonium and uranium compounds, fuel development, improved zirconium alloys and heat transfer studies. After enthusiastic response about 500 American and European research projects have been put before the Joint Board, set up under the agreement to evaluate proposals, and 45 research contracts had been approved by the beginning of August, 1960; altogether 28 Community and 10 United States organisations are involved, many of them being joint projects, while they cover an expenditure of $7·8 million, $5·6 million in the Community and $2·2 million in the United States.

(3) Fuel Supplies

The United States Atomic Energy Commission guarantees to supply Euratom with 30,000 kg of uranium 235 contained in enriched uranium over a 20 year period at American domestic prices; it guarantees the cost and performance of fuel elements and, until Euratom can itself cope, it offers chemical processing and related services, again at her own prices. Last July, this section was modified and added to under an Additional Agreement which provides for adequate supplies of fissile materials to be provided by the United States for the Euratom research programme, in particular the ORGEL project in Italy.

(4) Exchange of Information

Finally, the two parties agree to exchange unclassified information, while there is provision for each side to exploit under non-exclusive licences inventions and patents resulting from the joint programme.

United Kingdom-Euratom Agreement

An agreement was signed on 4 February, 1959, between the United Kingdom and Euratom for an initial ten-year period. The aim is " cooperation in the peaceful uses of atomic energy " between institutions and individual concerns in the United Kingdom and the Community. The main provisions are the exchange of information and training facilities, the provision of nuclear fuel and reactors by the United Kingdom, and the establishment of continuing and working committees of representatives of the two parties.

(1) Technical Interchange

The Commission and the UKAEA have undertaken to make available to each other non-classified information on the peaceful uses of atomic energy and to help individuals or firms to exchange information within the limits imposed by patents restrictions. They also agree to exchange technical advisers and to exchange students and technicians in their schools and training centres.

Exchanges of information and of technicians and trainees are already taking place and the continuing committee has started to meet at regular intervals. So far the main subjects for joint study have been the advanced gas-cooled reactor, the fast breeder reactor at Dounreay and the legal aspects of nuclear-powered ship propulsion and fusion. The UKAEA is to study controlled thermonuclear reactions at its Culham laboratory, while Euratom is doing so mainly at the Fontenay-aux-Roses Research Centre, France, and exchanges of technicians and information are planned.

(2) Mutual Assistance

The Commission and the UKAEA undertake to assist enterprises to obtain research and power reactors, to help each other to obtain appropriate materials and equipment; and, on commercial terms, to provide each other with aid in the design, construction and operation of plant for fuel manufacture and the processing of fuel. There has been little recourse to this section of the Treaty owing to the very limited scale of power reactor construction in the Community; but it will undoubtedly become increasingly important in the years to come.

(3) Fuel Processing and Supply

The UKAEA undertakes to supply, on commercial terms, fuel for research and power reactors supplied by Britain or, in specific cases, for other reactors; it may also assist the Euratom Agency to obtain fuel supplies. It will reprocess or arrange for the processing in the United Kingdom of fuel from Community research and power reactors. And, at Euratom's request it will buy back excess plutonium produced in reactors consuming British-supplied fuel. Fuel is being supplied under this section of the Agreement for a Jason reactor, supplied to Holland. (Atomic Review, 14 Oct. '60.)

Canada-Euratom Agreements

The Canada-Euratom agreements were signed on 6 October, 1959: one agreement was with the Canadian government, and the other, a technical agreement with Atomic Energy of Canada Limited.

The agreement with the Canadian Government sets out the terms governing the exchange of information, nuclear materials, reactors and other equipment, the exploitation of patented information, and the use of each other's equipment and training facilities; and in particular it covers the launching of a joint research programme in the field of natural-uranium fuelled, heavy-water moderated reactors. As with the other two agreements, the Canadian agreement's scope is limited to the peaceful uses of atomic energy and again cooperation is dependent upon proper safeguards and control arrangements.

The agreement with Atomic Energy of Canada Limited is initially to span five years, and is concerned with research and development on the natural-uranium heavy-water moderated reactor to assist in overcoming some of the technical problems still outstanding. Each side will contribute up to $5 million, and the agreement provides for joint exploitation of inventions and discoveries resulting from the joint programme.

ORGEL and OCDRE

There are already tangible results. A Joint Board has met and has decided that research will be concentrated on two types of heavy water moderated reactor: the ORGEL project at Euratom's Ispra research centre where a 5 MW heavy-water moderated and cooled water reactor using 20 per cent enriched uranium has been installed and a further addition will be made later. and the OCDRE project is the Canadian counter part.

Draft Agreement with Brazil

Finally, an agreement has been drafted for cooperation between Euratom and Brazil and has reached the final stage of discussion. A leading feature will be aid for Brazil's nuclear development, particularly for the training of technicians and for ore prospecting.

Admission of New Members

There have been no applications for membership of Euratom from countries which have not signed the Treaties of Rome, and any such application would clearly have to follow on a political decision to accept the aims and techniques of the Community.

Altogether nine countries have diplomatic missions accredited to Euratom: they are the United States, the United Kingdom, Denmark, Israel, Norway, Sweden, Switzerland, Austria, Canada. Six more are expected to become accredited.

Relations with International Organisations

The Euratom Commission in the name of the Community, is establishing links with agencies,

such as the International Atomic Energy Agency at Vienna and appropriate sections of the United Nations Organisation.

All Euratom countries are members of the OEEC and its specialised agency, the European Nuclear Energy Agency, set up on 1 February, 1958. Two important research projects in the ENEA's programme are the Dragon Project at Winfrith Heath, for the construction of a high-temperature gas-cooled reactor, for which Euratom is contributing 43·4 per cent of the total $38 million cost and more than 30 members of the Commission's research staff are working on it; and the Halden Reactor, a 20 MW boiling-water reactor in Southern Norway, where five Euratom staff are included in the staff. The Halden reactor, which is illustrated in the figure shown, first went critical in June 1959. (See Reactor Notes).

Recently five Euratom countries' governments and companies have subscribed more than half the $21 million capital for the Eurochemic Company of which 12 OEEC countries are members (the others are Austria, Denmark, Norway, Portugal, Spain, Sweden, Switzerland, Turkey). Eurochemic is building a plant at Mol, Belgium, for the chemical processing of irradiated fuel. This plant will be in operation in 1963, and will be able to treat 350 kg of irradiated fuel per day of operation.

Documentation Centre

All three bilateral cooperation agreements provide for the exchange of information, and are thus of great importance for the Documentation Centre which Euratom is setting up. The centre will be a clearing house for all information relating to nuclear energy, and will gather information from all parts of the world, translate it, classify it and circulate it, to make it available to national authorities and research centres. Apart from a library and a translation section there will be a documentation pool divided into three sections. One will cover documents on the "exact sciences," physics, chemistry, biology, etc. The second will contain résumés of reports and articles dealing with social sciences, economics, law, politics. Both these pools will publish monthly or fortnightly abstracts of nuclear literature to which all three authorities would contribute. The third section will be operated by Euratom alone. To be known as "Transatom," it will index information on translations from documents in Slav or Oriental languages. It is intended that all nuclear countries should be able to join in "Transatom's" work.

Common Market for Nuclear Materials

A common market for all nuclear materials was set up on 1 January, 1959, and trade between member states was freed on that date and a harmonised external tariff for imports was established. The tariff on certain fissile and fertile materials and their ores is nil; a 10 per cent duty on reactors and certain reactor parts has been suspended until the end of 1961, and tariffs ranging from 5 to 12 per cent on other products are suspended until the end of 1963. Lists of the materials or parts concerned are published in the treaty establishing Euratom. The Community is therefore completely open for the time being for imports of a very wide range of nuclear products. Apart from reactors and reactor spares it is intended to bring other products on the list of reactor parts which are of particular importance to Euratom into the liberalisation programme.

Notes and News

Oxygen Meter

Oxygen in even the smallest quantities is undesirable as an impurity in the sodium or sodium-potassium coolant of liquid-metal cooled reactors. In the fast reactor at Dounreay it is particularly important to exclude oxygen, which would act on the niobium fuel cans. To keep the oxygen content to a minimum and so avoid the formation and deposition of oxide in the circuits, Dounreay engineers have developed a detecting instrument based on a resistivity meter. The presence of one part per million of oxygen in the coolant raises the resistivity of liquid sodium-potassium at 300° C by about 100 p.p.m. The temperature coefficient of sodium is also high and only 0·04° C change is necessary to produce a 100 p.p.m. resistivity change. The meter operates on liquid metal drawn from the main circuit and passed through a toroidal pipe forming the secondary load of a transformer with a double-loop magnetic core. The instrument has also been used for locating the origin of gas entrainment.

The first steam to be produced by the world's first boiling heavy water reactor at the OEEC Halden project.

Winfrith Misinterpreted

In our account of work in progress at Winfrith Heath (Atomic Review, 30 September), certain errors in the text remained uncorrected owing to a break in the normal checking procedure. In fact, the reactor being built under project Dragon is expected to have a maximum power output of 20 MW(t), and the fuel will be enriched uranium 235, with thorium 232 as fertile material. Both the uranium 235 and thorium 232 will be in the form of carbides. The mean power density in the core will be some 14 MW per cubic metre, giving a mean heat flux per sq. cm of fuel-element surface of 24 watts. Fuel-box surface temperatures exceeding 1,200° C are anticipated. Control of the Zenith reactor, also mentioned in the report, is by means of 20 rods, though an additional 10 holes have been provided to take fixed absorber rods if required. It should also be emphasised that the European Nuclear Energy Agency of OEEC is intimately associated with the project. Correct details of the Dragon reactor have previously appeared in ENGINEERING: vol. 186, 1958, p. 336; vol. 187, 1959, p. 239; vol. 189, 1960, p. 484; vol. 189, 1960, p. 586; and vol. 189, 1960, p. 618.

It was also wrongly stated that control of the Jason reactor (the model at Winfrith Heath being known as Nestor) was obtained by varying the level of the water or bubbling nitrogen gas through the water in the annulus. In fact, control is obtained by means of movable cadmium absorbers operated by the fine and coarse control-rod mechanisms, and similar shutdown mechanisms are provided. The facility of dumping the moderator water is an additional safety feature of this reactor, and is used on normal and emergency shutdowns. The maximum possible rate of rise in the water level during startup is regulated by limiting the pump capacity so that the rate of addition of reactivity from this source is limited, but this operation is carried out in the condition of maximum absorption by the control and safety rods. The nitrogen bubble system is an optional safety feature which increases the voidage in the moderator and hence reduces the activity. This system is also a useful means of demonstrating and measuring the void coefficients, but is not considered as a control feature.

Literature Search

A booklet has been published by USAEC on *Selected Reactors of the Power Reactor Demonstration Programme* which lists the 314 reports published on the 10 power reactor projects under construction or planned, and gives the title, author, publication date, price and availability.

Reactor Notes

Boiling Reactor Brews Up: The OEEC's heavy-water boiling reactor at Halden achieved boiling for the first time on 5 October, during which time the reactor power was 2 MW but will ultimately be raised to 20 MW. The first reactor of this type in the world, it originally went critical in June, 1959, and the first part of the experimental programme comprised a series of low-power tests to obtain information on reactor physic parameters. The reactor was then shut down for routine checks and modification work necessary before continuous power operation. It went critical for the second time last August.

Tender Consideration: Mr. Marples, Minister of Transport, recently stated that considerable time would be required to evaluate the five tenders that had been received in connection with the supply of a reactor for a proposed nuclear powered ship.

Oldbury Approved: Permission has been granted by the Minister of Power for the construction of a 550 MW nuclear power station at Oldbury-on-Severn. This is the third station to be placed within a 50 mile stretch along the Severn estuary—the other two being Berkeley and Hinkley Point. It is estimated to be completed in 1966, having been postponed by a year due to the slowing down of the nuclear programme.

More Russian News: In addition to the four fast neutron reactors of the Mark EN 1-5 type now in operation, Russia will also have a Mark BN-50 sodium-cooled fast reactor fuelled with 200 kg of plutonium. It is due to go critical next year. Swimming pool reactors have been or are being built at Leningrad, Kiev, Minsk, Tbilisy, Sverdlovsk, Tomsk and Taschkenk. At the Obninsk research centre the reactors include a beryllium moderated reactor and four plutonium reactors and a 2 MW mobile power station.

Cape Research Centre: Work is shortly to begin on a £500,000 nuclear research centre for the universities of Cape Town and Stellenbosch, and a 300 acre site at Faure near Cape Town is now being surveyed.

Future for Fused Salt: In the anticipation of reducing fuel costs, a 5 to 10 MW fused-salt reactor is to be built at Oak Ridge National Laboratory to experiment with the system. The reactor will operate at 1225° F and will have a cylindrical core 4½ ft diameter and 5½ ft high. The fuel will be a solution of fluorides of lithium 7, beryllium, uranium, zirconium and thorium which will be pumped through the 600 columns in the graphite. The core will be housed in a pressure vessel of INOR-8 which is a nickel base alloy containing molybdenum and chromium.

Number Two for Japan: Japan has signed a contract with the United States General Electric Company for the construction of a 12·5 MW boiling-water reactor at Tokai Mura, the Japanese research centre. It is scheduled to go critical in early 1963, and is expected to produce the first nuclear electric power in the Far East.

The

'Engineering' Appointments

Section

ENGINEERS
for
TUBE INVESTMENTS LTD.

Applications are invited from well-qualified and experienced Mechanical or Electrical Engineers, between 28 and 40 years of age, for a number of responsible and progressive posts in member companies of the T.I. Group in various parts of the country.

Candidates, who must possess a Higher National Certificate or Engineering Degree, should be corporate members of the appropriate professional institution and should preferably have served a full apprenticeship.

In addition, they must be able to demonstrate that they have had thorough practical training and experience in the manufacture, installation, operation or maintenance of medium to heavy plant and its ancillary equipment.

Experience of modern techniques of preventive maintenance would be an advantage and proved ability in the handling of shop floor problems is essential.

A number of interesting projects are taking shape within the Group and the successful candidates will find challenging work and ample opportunity for advancement.

Starting salaries will depend on the age, qualifications and experience of the individual. There are Pension and Family Education schemes in operation.

Please apply in writing to:—

The Director of Personnel,
Tube Investments Limited,
Woodbourne Grange,
21 Woodbourne Road,
Edgbaston,
Birmingham 17

D 411

PUBLIC APPOINTMENTS

CAMBRIDGESHIRE EDUCATION COMMITTEE
CAMBRIDGESHIRE TECHNICAL COLLEGE AND SCHOOL OF ART

Principal: D. E. MUMFORD, M.A.

LECTURER IN ELECTRICAL ENGINEERING required 1st JANUARY, 1961, for work with HIGHER NATIONAL CERTIFICATE and HIGHER NATIONAL DIPLOMA SANDWICH COURSES.

Candidates must have graduate or equivalent professional qualifications, with appropriate experience in industry and teaching.

Salary: Burnham Scale for Lecturers in Establishments of Further Education, i.e. £1370 by £35 to £1550.

Further particulars and forms of application may be obtained from the PRINCIPAL, CAMBRIDGESHIRE TECHNICAL COLLEGE AND SCHOOL OF ART, COLLIER ROAD, CAMBRIDGE.

G. D. EDWARDS,
Chief Education Officer. D 403

UNIVERSITY OF SYDNEY
SENIOR LECTURESHIP AND LECTURESHIP/SENIOR LECTURESHIP IN AERONAUTICAL ENGINEERING

Applications are invited for the above-mentioned positions. In each case the successful applicant will be required to lecture in Aerodynamics and to avail himself of the excellent opportunities for research.

The salary for a Senior Lecturer is within the range £A2550 by £A95 to £A3000 per annum; for a Lecturer within the range £A1750 by £A105 to £A2435 per annum. In each case cost of living adjustments will be allowed. The salary is subject to deductions under the State Superannuation Act. The commencing salary will be fixed according to the qualifications and experience of the successful applicant.

Under the Staff Members' Housing Scheme in cases approved by the University and its Bankers, married men may be assisted by loans to purchase a house.

Further particulars and information as to the method of application may be obtained from the SECRETARY, ASSOCIATION OF UNIVERSITIES OF THE BRITISH COMMONWEALTH, 36, GORDON SQUARE, LONDON, W.C.1.

Applications close, in Australia and London, on 31st DECEMBER, 1960. D 402

SCOTTISH HOME DEPARTMENT
ENGINEERING ASSISTANT

Applications are invited for a post of Engineering Assistant Grade III for work connected with Materials and Soil Testing at a new Materials Testing Station at Drem, East Lothian.

Candidates should be men preferably over 25 who have served an apprenticeship or equivalent period of training with at least three years' subsequent experience, e.g., with a civil engineering contractor, local highway authority or consulting engineers. Preference will be given to candidates who have obtained the Ordinary National Certificate, of City and Guilds Certificate or are of equivalent technical standard.

Salary £745 (age 25) rising to £825 (age 28 or over); scale maximum £925. Unpensionable at first but opportunity to gain pensionable post.

Applications, with details of qualifications, experience and age to ESTABLISHMENT OFFICER, SCOTTISH HOME DEPARTMENT, ROOM 364, ST. ANDREW'S HOUSE, EDINBURGH, 1, by 3rd DECEMBER, 1960.

D 389

COUNTY BOROUGH OF EAST HAM
JUNIOR ENGINEERING ASSISTANT (MECHANICAL), APT. I

Salary up to £855 per annum.

A subsistence allowance may be granted over a reasonable period to the person appointed if unable to obtain suitable housing accommodation, necessitating the maintenance of two homes.

Further details and application form returnable by 2nd DECEMBER, 1960, from the TOWN CLERK, TOWN HALL, EAST HAM, E.6. D 410

THE UNITED LIVERPOOL HOSPITALS

Applications are invited for the post of ENGINEERING ASSISTANT to assist the Superintendent Engineer. The duties will include the preparation of drawings and specifications. Candidates should be competent draughtsmen and experienced in heating and ventilating and general engineering work and should hold the Higher National Certificate in Mechanical Engineering or its equivalent. The salary is on the scale £600 by £25 (6) by £30 (3) to £840 per annum and a candidate with suitable experience may enter the scale above the minimum. The Terms and Conditions of Service are those of the appropriate Whitley Council.

Apply stating age, qualifications, experience and the names and addresses of three persons to whom reference may be made to the SECRETARY, THE UNITED LIVERPOOL HOSPITALS, 80, RODNEY STREET, LIVERPOOL 1, by the 2nd DECEMBER, 1960. D 394

PRODUCTION ENGINEER

required for service with international manufacturing and distributing company near Calcutta, India.

Preference will be given to candidates with a good Engineering Degree, and the following qualifications are required:—

(i) Experience in machinery design and construction.
(ii) Ability to direct machinery design personnel.
(iii) Good knowledge of hydraulics.
(iv) Ability to transfer ideas for improvement to good engineering design.

Responsibilities will include:—

(i) Production of machines and spare parts.
(ii) Production of equipment.
(iii) Foundry.
(iv) Heavy construction—including structural work.
(v) Electrical installation.

This post is a senior one with commensurate salary. Amenities include free medical attendance, local and overseas leave, furnished accommodation provided and free accident insurance.

Two to three months preparatory training period for the post will be provided in the United Kingdom.

Write in first instance to: **PERSONNEL MANAGER,**
BATA DEVELOPMENT LIMITED,
151, Oxford Street, London, W.1

D 384

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF SUPPLY

DEFENCE STANDARDS LABORATORIES, MELBOURNE

METROLOGY

Applications are invited for position of

HIGHER SCIENTIFIC OFFICER

SALARY: £2005–£2265 (Australian currency)

DUTIES: Study of methods for the precise measurement of force with a view to the development of secondary standards for calibration of large engineering equipment.

QUALIFICATIONS: Honours degree in Mechanical Engineering.

NOTE: Applicants who do not have the necessary experience may initially be appointed as Scientific Officer, Grade I (£1510–£1895) and at a later date may be promoted to Higher Scientific Officer.

TRAVEL: Under specified conditions, first class air/sea transport for the appointee and dependents (wife and dependent children) will be provided by the Commonwealth.

CONTRACT EMPLOYMENT: If desired by the successful candidate consideration may be given to entering into an agreement for a three (3) or five (5) year contract of employment in Australia. In this case the Commonwealth will bear the cost of return fares; together with the cost of removing the successful applicant's furniture and effects up to a maximum cost of £500 (Australian), £250 each way.

APPLICATIONS: Forms obtainable from Senior Representative (AV 81/6), Department of Supply, Australia House, The Strand, London, W.C.2, with whom completed applications should be lodged by 9th December, 1960. D 385

APC

DESIGN ENGINEERING

Expansion of the Company's Laboratories at Heston, Middlesex, has created the following vacancies on the design staff:—

CHIEF DESIGN ENGINEER

To be responsible for mechanical, thermal, electrical and aerodynamic design of test rigs used to obtain data on the properties of fuel elements and other components under simulated nuclear reactor conditions.

Applicants should have served a recognised apprenticeship and have had at least 10 years experience in one or more of the following fields—nuclear engineering, gas turbines, steam turbines, heat transfer, oil refinery equipment.

DESIGN ENGINEERS

To be responsible to the Chief Design Engineer for the detailed mechanical and electrical design of the rigs referred to above. Applicants should have had several years design experience and have served a recognised apprenticeship.

DESIGN DRAUGHTSMEN

To be responsible to the Chief Draughtsman for the layout work on the test rigs concerned. Applicants should have suitable Drawing Office experience, preferably in the fields indicated above.

Applications giving full details of experience should be addressed to:—

The Personnel Manager, (Ref. E/149),
ATOMIC POWER CONSTRUCTIONS LIMITED, P.O. Box 90,
28 Theobalds Road, London, W.C.1

D 392

HSBT

have the following vacancies:—

1. ONE SENIOR INSTALLATION DRAUGHTSMAN

Applicants should have a minimum of seven years' experience in a Drawing Office, on the installation of land turbine or diesel plant, and be capable of initiating schemes for foundations, boiler plant, installation of auxiliaries and piping services. H.N.C. is desirable.

2. TWO INSTALLATION DRAUGHTSMEN

Applicants should have a minimum of four years Drawing Office experience in the layout and detailing of turbine or diesel plant in power stations or ships. Duties would include the preparation of tender drawings and the detailing of auxiliary services. Minimum qualification O.N.C.

Interested applicants should write in the first instance stating age, experience and qualifications and salary required to:—

THE PERSONNEL MANAGER,
HAWKER SIDDELEY BRUSH TURBINES LIMITED,
HUCCLECOTE, GLOUCESTER

D 386

ADMIRALTY—NAVY WORKS DEPT.

ELECTRICAL & MECHANICAL ENGINEERING DRAUGHTSMEN

Vacancies exist in Navy Works Department Drawing Offices as shown below and occur at Establishments elsewhere in United Kingdom from time to time.

The posts are non-pensionable but there will be opportunities for transfer to the Established staff.

Applicants must be competent Draughtsmen and experienced in one or more of the following types of work:—

Electrical (vacancies at Pinner (Middx.), Portland and Devonport).
(*a*) Preparation of specifications, drawings and schedules for electrical equipment. Précis of firms' tenders.
(*b*) Electrical installations in domestic and industrial buildings.
(*c*) Cable installations, switchgear etc.
(*d*) Airfield lighting.

Mechanical (vacancies at Pinner (Middx.), Portsmouth, Portland, Liverpool, Rosyth, London).
(*a*) Preparation of specifications, drawings, schedules and précis of firms' tenders.
(*b*) District heating, including boiler installations, heating and air conditioning of domestic and specialist buildings.
(*c*) Layouts of engineering installations and workshop machinery.
(*d*) All classes of lifting appliances, pumping installations, test plants, cooking equipment, etc.

Possession of O.N.C. or similar qualification will be an advantage. Consideration will be given to successful candidates being granted assistance to obtain technical qualifications.

Salary (Men): National Rate—subject to slight variation dependent on location: starting from £580 (at age 21) to £870 (28 and over): maximum of scale—£955 p.a. (National Rate).

Opportunities occur for promotion to Leading grade—salary maximum £1115 p.a. (National Rate).

Five-day week: annual leave 18 days rising to 22 after 10 years.

Candidates, who must be British subjects, are invited to apply in writing, giving details of qualifications and experience to Director General, Navy Works, Admiralty, Chamberlain Way, Pinner, Middlesex.

D 313

BRITISH STANDARDS INSTITUTION

HEMEL HEMPSTEAD CENTRE

An ENGINEER is required by the B.S.I. in connection with their testing station at Hemel Hempstead.

The work will be varied and will include visits to the works of manufacturers, the testing of samples selected on such visits and the setting up and operation of laboratories associated with Certification Marks schemes.

Applicants should preferably be graduates of the Institution of Electrical Engineers or of the Institution of Mechanical Engineers, and should have served an articled apprenticeship.

The starting salary will be commensurate with qualifications and experience. The post is pensionable.

Apply to the
ESTABLISHMENT OFFICER,
B.S.I.,
2 PARK STREET,
LONDON, W.1,
quoting Reference ENG.(H.H.).

D 387

THE CORPORATION OF THE CITY OF GLASGOW

WATER DEPARTMENT

APPOINTMENT OF GENERAL MANAGER

The Corporation invite applications for the appointment of GENERAL MANAGER of the CORPORATION WATER DEPARTMENT.

The salary for the appointment is £3780 per annum, rising to £4095 per annum by increments of £63 per annum. The person appointed will be responsible for the whole administration, supervision and control of the Department. The appointment is subject to the provisions of the Corporation's Superannuation Scheme and the successful candidate will require to pass a medical examination.

Applicants must be under 55 years of age at 1st November, 1960, except as regards employees of the Corporation.

Applications stating date of birth and full particulars of qualifications and experience, with names and addresses of three referees, to be lodged with me in an envelope endorsed "APPOINTMENT OF GENERAL MANAGER, WATER DEPARTMENT," not later than 1st DECEMBER, 1960.

ALEXANDER ROOKE,
TOWN CLERK.

CITY CHAMBERS, GLASGOW. D 334

WORCESTERSHIRE COUNTY COUNCIL

(A) CHIEF ASSISTANT BRIDGE ENGINEER—SCALE "B" (£1475–£1670)

(B) ENGINEERING ASSISTANT "BRIDGES"—GRADE APT V (£1310–£1480)

C) SURVEYOR-DRAUGHTSMAN—MISC. VI (£760–£825)

Applications are invited for the above-mentioned superannuable posts on the permanent establishment of the County Surveyor's Department starting at the minimum of the grades except in special circumstances.

Applicants for posts (A) and (B) should be Corporate Members of an appropriate Engineering Institution, experienced in design and construction of bridges. The former post is to be filled by a man capable of supervising the design and construction of bridge schemes of considerable magnitude. Those applying for post (B) should have had good general bridge experience.

Applicants for post (C) should either be accustomed to general survey work and draughtsmanship involved by road improvement schemes, or have experience of bridge works detailing. In the case of posts (B) and (C) only the County Council will consider making a contribution towards furniture removal expenses, and to paying a lodging allowance of £2 per week in certain circumstances up to a period of six months.

Applications to be forwarded to COUNTY SURVEYOR, COUNTY BUILDINGS, WORCESTER, as soon as possible, but not later than first post on WEDNESDAY, 23rd NOVEMBER, stating age; qualifications; experience, present appointment, grade and salary; names and addresses of two referees. (F.192)

D 395

INSTRUMENT MAKER

MINISTRY OF LABOUR require INSTRUMENT MAKER as Instructor (unestablished) at LEICESTER GOVERNMENT TRAINING CENTRE. Must be British subject, experienced, fully skilled (normally for at least 5 years), able to teach his trade and supervise the work and maintain control of trainees. Should preferably possess O.N. or C. & G. cert. or equiv. qualification. Will be required to pass theoretical test before appointment and practical test of normal trade skills after taking up appointment. Prospect of eventual establishment. Salary £955 (at age 30 or over) rising by annual increments to £1030 p.a.—Write for application form to: MANAGER, MINISTRY OF LABOUR, GOVERNMENT TRAINING CENTRE, HUMBERSTONE LANE, LEICESTER, within 7 days. D 408

BUCKINGHAMSHIRE EDUCATION COMMITTEE

SLOUGH COLLEGE OF FURTHER EDUCATION

Principal: R. Edgar, M.Sc., M.A.

ASSISTANT GRADE B IN MECHANICAL ENGINEERING required in January or as soon as possible, to teach mainly Engineering Drawing and Science up to S3 standard, with some similar work with City and Guilds Machine Shop students. Qualifications will be considered on their merits.

Salary on the Burnham Technical Scale £700 by £27 10s. to £1150 with additions for training and graduate qualifications and increments for suitable teaching and industrial experience.

Further particulars and application form, to be returned within 14 days of the appearance of this advertisement, from the PRINCIPAL, SLOUGH COLLEGE OF FURTHER EDUCATION, WILLIAM STREET, SLOUGH. D 400

HUDDERSFIELD COLLEGE OF TECHNOLOGY

Principal: Dr. W. E. Scott, M.B.E.

DEPARTMENT OF CIVIL AND MECHANICAL ENGINEERING

Required as soon as possible TWO TEACHERS OF MACHINE SHOP ENGINEERING SUBJECTS in City and Guilds courses. For one of these posts experience in Tool Room work would be an advantage.

Salary (Burnham Scale), Grade A or B according to qualifications and experience.

Grade A: £520 p.a. by £27 10s. p.a. to £1000 p.a.
Grade B: £700 p.a. by £27 10s. p.a. to £1150 p.a.

There are additions for approved qualifications and training and the commencing salary may include increments for approved industrial experience.

Forms of application and further particulars obtainable from the PRINCIPAL, to whom applications should be returned without delay.

H. GRAY,
Clerk to the Governors.

3rd November, 1960. D 393

NIGERIAN COLLEGE OF ARTS, SCIENCE AND TECHNOLOGY

Applications are invited for a TECHNOLOGIST or SENIOR TECHNOLOGIST (ELECTRICAL) for the engineering laboratory and workshops for students preparing for University of London B.Sc. (Eng.) in Special Relationship.

QUALIFICATIONS: H.N.C. or O.N.C. or appropriate City and Guilds qualification in Telecommunications. Good experience on maintenance and construction of electronic equipment and instrument maintenance essential.

CONTRACT SALARY SCALES: Technologist £756-£1284 p.a., Senior Technologist £1140-£1440 p.a., both plus inducement addition of £180-£300 p.a. for overseas appointees and gratuity at £25 or £37 10s. for each completed 3 months' residential service. Entry point according to qualifications and experience.

Partly furnished quarters at one-twelfth basic salary rental. Tours 15-18 months. Free passages for appointee and wife. Children's passages assistance and maintenance grant up to £150 p.a. if left in U.K.

Applications (8 copies) giving age, qualifications, experience and names of 3 referees should be sent to THE COUNCIL FOR OVERSEAS COLLEGES, 12 LINCOLN'S INN FIELDS, LONDON, W.C.2, by 9th DECEMBER, 1960. D 419

GLAMORGAN EDUCATION AUTHORITY
GLAMORGAN COLLEGE OF TECHNOLOGY
TREFOREST, NR. PONTYPRIDD

Applications are invited for the post of SENIOR LECTURER IN MECHANICAL ENGINEERING. This is a new post and the successful candidate will be required to teach to Higher National Diploma level in two of the following subjects: Theory of Machines, Fluid Mechanics, Applied Thermodynamics, Strength of Materials.

Candidates should possess a degree in engineering or other equivalent professional qualification together with teaching and industrial or research experience. Owing to the transfer of junior and senior work to the new Pontypridd College of Further Education, the Glamorgan College of Technology will, in future, in general be concerned with advanced work only.

Salary in accordance with the Burnham Technical Scale, viz.: £1550 by £50 to £1750 per annum.

Application forms and further particulars obtainable from the undersigned in receipt of a stamped, addressed foolscap envelope. Last date for receipt of completed forms is 26th NOVEMBER, 1960.

EMLYN STEPHENS,
Director of Education.
COUNTY HALL,
CARDIFF. D 431

THE ROYAL COLLEGE OF SCIENCE AND TECHNOLOGY GLASGOW

Applications are invited from honours graduates for a

RESEARCH STUDENTSHIP

in the Department of Mechanical, Civil and Chemical Engineering, annual value £500. The Studentship will be tenable for three years and should normally lead to higher degree.

The successful applicant will be required to undertake research on the strength and stability of thin walled structural forms.

Forms of application from the

Secretary,
George Street,
Glasgow, C.1.
D 429

NORTHAMPTON COLLEGE OF ADVANCED TECHNOLOGY LONDON, E.C.1

Applications are invited, especially from those in industry, for the following appointments:—

(a) LECTURER IN ELECTRICAL POWER AND MACHINES.
(b) LECTURER IN ELECTRONICS OR MEASUREMENTS.
(c) LECTURER IN GENERAL ELECTRICAL ENGINEERING.
(d) ASSISTANT LECTURER IN GENERAL ELECTRICAL ENGINEERING.

The work of the Department is concerned with the B.Sc.(Eng.) Internal Degree of the University of London, Industrially-Based Sandwich Course leading to the Diploma in Technology (Dip Tech. (Eng.)), Postgraduate courses in Electrical Engineering and Full-Time Research.

The posts also provide facilities for research, development and experience in industrial liaison. Applicants should possess a Degree in Electrical Engineering, and will be encouraged to read for a Higher Degree.

SALARY SCALES:—
LECTURER: £1370 by £35 to £1550 per annum.
ASSISTANT LECTURER: £895 by £27 10s. 0d. to £1345 per annum.

Plus, in each case, a London Allowance of £38 increasing to £51 at age 37. Starting salary dependent upon industrial or teaching experience.

Particulars and form of application from the SECRETARY, NORTHAMPTON COLLEGE OF ADVANCED TECHNOLOGY, ST. JOHN STREET, E.C.1. D 423

WELSH COLLEGE OF ADVANCED TECHNOLOGY
DEPARTMENT OF ENGINEERING

Applications are invited for the following posts, duties to commence as soon as possible:—

1. LECTURER IN MECHANICAL ENGINEERING. Applicants must be University Graduates in Engineering, and should normally be graduates or corporate members of the Institution of Mechanical Engineers and have had adequate industrial experience.

2. LECTURER IN MECHANICAL ENGINEERING WITH SPECIAL KNOWLEDGE OF MARINE ENGINEERING. Applicants shodul be University graduates in Engineering or corporate members of the Institution of Mechanical Engineers and should preferably hold a first class M.O.T. Certificate together with at least graduate membership of the Institute of Marine Engineers.

Salary for both posts—£1370 to £1550 per annum, with placing upon the scale dependent upon experience.

Further particulars and forms of application may be obtained from the REGISTRAR AT THE COLLEGE, CATHAYS PARK, CARDIFF, to whom completed forms should be returned by 3rd DECEMBER, 1960.

ROBERT E. PRESSWOOD,
Clerk to the Governors.
CITY HALL,
CARDIFF. D 421

APPOINTMENTS OPEN

RESEARCH ENGINEER (OIL HYDRAULICS)

Applications are invited for a vacancy in a small team in the central research establishment of the Vickers Group. The team is building up novel technologies and developing new types of hydraulic mechanisms. The work requires a thorough understanding of basic principles and the ability to apply it to non-conventional fields. Previous experience in Oil Hydraulics not essential. Candidates should have some post graduate engineering experience and a good honours degree, or its equivalent, in physics or engineering. The post is not administrative. The salary is commensurate with ability, qualifications and experience. Applications should be supported by a brief statement of qualifications and experience and sent to the MANAGING DIRECTOR, VICKERS RESEARCH LIMITED, SUNNINGHILL, ASCOT, BERKS. D 345

DRAUGHTSMEN

Pilkington Brothers Limited have vacancies in their Technical Development Department for three senior and one junior Mechanical Draughtsmen. The work involves the production of design and detail drawings for new plant and for modifications to existing machines. The draughtsmen work closely with Development Engineers on a wide range of problems from small precision mechanisms to automatic glass-handling equipment.

Age range:—Seniors 25-45; Junior 21-25.

Qualifications: Seniors, H.N.C. preferred, but general engineering experience essential. Junior preferably with O.N.C. and general engineering apprenticeship.

Applications, stating age, qualifications and experience, should be addressed to Mr. C. S. Drake, Group Staff Department, Pilkington Brothers Limited, St. Helens, Lancashire. D 381

TAKERS OFF AND WORKERS UP

Firm of CHARTERED QUANTITY SURVEYORS require TAKERS OFF and WORKERS UP for large Civil Engineering and Building works in the SHEFFIELD AREA. Positions offer scope for advancement.—Reply stating age, experience and salary required to BOX D 373, Offices of ENGINEERING.

STEIN ATKINSON VICKERS HYDRAULICS LTD.

wish to appoint a

SENIOR APPLICATIONS ENGINEER

for their LONDON OFFICES. A sound practical knowledge of all types of machine tools is essential including some experience of Oil Hydraulics. This post relates to the application of Hydraulic equipment and involves the preparation of circuits, quotations and technical discussions with user Engineers. The applicant should have served an Engineering apprenticeship. A degree or similar qualification would be an advantage. Please apply in writing stating salary expected to

CHIEF APPLICATIONS ENGINEER,
STEIN ATKINSON VICKERS HYDRAULICS, LTD.,
197, KNIGHTSBRIDGE,
LONDON, S.W.7
D 408

MSL *have been retained to advise on the appointment of a*

TECHNICAL MANAGER

for a company in the South of England specialising in the design, development and construction of heavy machinery for the steel and allied industries. He will le responsible to the Divisional Manager (Director) for technical sales activities and the engineering of hot rolling mills to the contract stage. Salary around £2500, contributory pension scheme.

Candidates, qualified mechanical engineers, preferably over 35, must have specialised knowledge and experience either in the design and construction, or the operating of hot rolling mills. As some European travel sill be involved, the ability to speak French or German would be an advantage, but is not essential. Please send brief details in confidence quoting reference F.3200 to H. C. S. Brand.

MANAGEMENT SELECTION LIMITED
17 Stratton fftreet, London, W.1

In no circumstances will a candidate's identity be disclosed to our client unless he gives permission after a confidential interview at which he will be given full details of the appointment. D 433

ADMIRALTY QUANTITY SURVEYING ASSISTANTS
NAVY WORKS DEPARTMENT

requires QUANTITY SURVEYING ASSISTANTS at Offices at Pinner (Middlesex), Chatham, Portsmouth, Portland, Liverpool, Greenock and Rosyth.

Duties include abstracting and billing, preparation of estimates, site measurements, settlement of final accounts, etc. Possession of qualifications such as City and Guilds, O.N.C. (Building or Builders Quantities) an advantage. Assistance given for recognised courses of study to enable technical qualifications to be obtained.

Promotion and pension prospects. Five-day week, 18 days Annual Leave rising to 22 days after 10 years.

SALARIES (National Rates subject to slight variation depending on location):—

Grade II £950 p.a. on entry to £1085.
Grade III £670 p.a. at age 21 to £850 p.a. at age 28 or over. Maximum £950
Grade IV £520 p.a. at age 20 to £710 at age 28 or over. Maximum £850.

Candidates must be British subjects and should apply in writing giving details of qualifications and experience to:—

Director General, Navy Works,
ADMIRALTY
CHAMBERLAIN WAY, PINNER, MIDDLESEX
D 409

WORKS MANAGER-DIRECTOR

A keen young engineer with first class knowledge of modern works management required by old established expanding Public Company pre-eminent in hire car/P.S.V. operation. Factory employing 150 tradesmen situated in London. Applicants must have recent experience of similar position, involving fleet costing, budgetary control, etc. Starting salary £1500 p.a., pension scheme and usual benefits.

BOX D 427, Offices of ENGINEERING.

APC

have vacancies in their Central London Technical Department for senior and junior

MECHANICAL ENGINEERS
ELECTRICAL ENGINEERS
PHYSICISTS
MATHEMATICIANS

for theoretical work on heat transfer; reactor and steam plant optimisation, control and performance; reactor physics; radiation shielding; analogue computing.

The Company owns an Emiac II Analogue Computer and uses the Ferranti Mercury Digital Computer.

Applicants should hold a good honours degree and engineers should have had some industrial experience.

Applications giving full details should be sent to:—

The Personnel Manager (Ref. E 156),
Atomic Power Constructions Limited,
P.O. Box 90,
28 Theobalds Road, London, W.C.1
D 426

ENGINEER

ENGINEER, AGE 20-35, with electronic, electrical or mechanical engineering background, required for editorial staff of a successful industrial journal published in London. Applicants, who need not have previous journalistic experience, must be able to write clearly and concisely on technical subjects.—Reply, giving full details of age, education, training and experience, to BOX D 412, Offices of ENGINEERING.

ENGINEER SURVEYORS

ENGINEER SURVEYORS for the inspection of boiler and pressure plant required. Applicants should not be more than 38 years and must have First Class M.O.T. Certificate with steam endorsement or equivalent qualifications. Salary E.S.A. Scale starting at £806 per annum. Other benefits. Areas: Oxford and Windsor.

Apply ENG. DEPT., GENERAL ACCIDENT ASSURANCE CORP., LTD., 99, ALDWYCH, LONDON, W.C.2. D 401

AEI-BIRLEC LIMITED
manufacturers of industrial furnaces, wish to appoint a

WORKS MANAGER

having full responsibility for all Manufacturing activities at the Company's Erdington and Aldridge Factories. He will report to the appropriate Director on the Board.

A really outstanding man is required for this post and an appropriate salary will be paid. There is an excellent pension scheme and other benefits.

Please write, giving details of education, qualifications and experience to:—
THE MANAGING DIRECTOR
AEI-BIRLEC LIMITED
ERDINGTON
BIRMINGHAM, 24 D 390

DRAUGHTSMAN

Well known Commercial Organisation has vacancy in London Head Office for Structural Draughtsman. Previous experience with steel and reinforced concrete essential. Good salary and Non-contributory Pension Scheme.—Write giving age and details of experience to BOX D 420, Offices of ENGINEERING.

ENGINEER

ENGINEER required, enterprising enough to tackle a difficult, varied and interesting job which calls for a man qualified in the modern planning and production techniques necessary in an expanding light/medium engineering and foundry organisation. Salary, prospects and housing adequately catered for. Northern location.—BOX D 418, Offices of ENGINEERING.

MECHANICAL ENGINEER

MECHANICAL ENGINEER, H.N.C. STANDARD, required for non-destructive testing of materials and vessels. Specialised training will be given to successful candidate. Commencing salary £800 a year. Non-contributory pension.—BOX D 432, Offices of ENGINEERING.

HEATING AND VENTILATING ENGINEERS AND DRAUGHTSMEN

Assistant Design Engineers are required by the United Kingdom Atomic Energy Authority at Risley, to undertake individual design work of a high standard or lead small teams of draughtsmen on design of high and low pressure hot water and steam heating systems; hot water supply installations; ventilation and air conditioning systems.

Draughtsmen are also required to assist in the preparation of engineering drawings and plans.

Applicants for posts as Assistant Design Engineers must have served a recognised engineering apprenticeship or have had equivalent training. Good design experience in this field, and possession of an appropriate H.N.C., are essential.

Applicants for posts as Draughtsmen must have an appropriate O.N.C. or equivalent, and must have had good practical training with sound experience.

Graduate membership of the Institution of Heating and Ventilating Engineers may be an an advantage for all posts.

Salaries for Assistant Design Engineers will be between £930 and £1340.

The salary scale for Draughtsmen is under review, and is expected to be about £600 at age 21 rising to about £800 at age 25 and to a maximum of about £1000.

Contributory Superannuation.
Housing Assistance Schemes.

Send postcard for application form, quoting reference 421/J2, to:—

The Appointments Officer,
U.K.A.E.A.
DEVELOPMENT & ENGINEERING GROUP HEADQUARTERS,
Risley, Warrington, Lancashire

Closing Date: 5th December, 1960

D 391

SALES ENGINEER

SALES ENGINEER with mechanical experience and knowledge of hydraulic equipment for interesting work in connection with sales and development of mechanical handling equipment. Good remuneration and excellent prospects for advancement.—Apply, PERSONNEL OFFICER, GEORGE COHEN, SONS & CO., LTD., 600, WOOD LANE, W.12. D 404

MECHANICAL ENGINEER

The BRITISH OXYGEN CO., LTD., SCIENTIFIC DIVISION, have a vacancy for a MECHANICAL ENGINEER to undertake development work on pumps for fluids at low temperatures. Applicants should have a degree in mechanical engineering or equivalent qualifications and preferably some experience of pump design.

Please write to the ADMINISTRATION MANAGER, THE BRITISH OXYGEN CO., LTD., SCIENTIFIC DIVISION, DEER PARK ROAD, LONDON, S.W.19. D 428

AEI

ASSOCIATED ELECTRICAL INDUSTRIES LIMITED

The Research Department, Associated Electrical Industries (Manchester) Limited has vacancies for both GRADUATE and H.N.C. ENGINEERS for manufacturing research and development involving at present mainly machining processes. The activities include laboratory-based work on machine tools and processes, development work in conjunction with Manufacturing Divisions and evaluation of machine tools and associated control gear and drives. The experience and interests of applicants will be considered carefully in deciding the programmes of work.

Please write for application form quoting reference R.16 to:—

Personnel Manager,

Associated Electrical Industries (Manchester) Ltd.
Trafford Park, Manchester, 17.

G 893

AUSTRALIA

ENGINEERS

wanted for

New South Wales Government

MAIN ROADS DEPARTMENT—Civil.

METROPOLITAN, WATER, SEWERAGE AND DRAINAGE BOARD—Civil, Electrical, Mechanical and Chemical.

PUBLIC WORKS DEPARTMENT AND FORESTRY COMMISSION—Civil, Electrical and Mechanical.

Good salary and prospects.
Passage to Australia.
Superannuation benefits.
Graduates and diplomates only.

Further details from:—
AGENT GENERAL FOR NEW SOUTH WALES,
56, STRAND,
LONDON, W.C.2,
who will welcome enquiries. D 414

ELECTRICAL ENGINEER

Applications are invited from well qualified and experienced Electrical Engineers for the senior electrical appointment in a large British mining concern in West Africa.

Candidates, who must possess a Higher National Certificate or Engineering degree, should have previous engineering experience and have served a full apprenticeship. The preferred age is 27 to 40.

This is a permanent appointment arranged in 15 month foreign tours followed by 3 months' leave. The Company provides passages and housing. Although in a tropical climate the post is healthy and suitable for children.

The starting salary will depend on the age and qualifications of the individual. The Company operates a non-contributory pension scheme and salary is taxed well below the U.K. level.

Applications in the first place to BOX D 422, Offices of ENGINEERING.

ESTIMATING ASSISTANT

ESTIMATING ASSISTANT for London Office of large North Country Engineering Concern. Applicants should hold O.N.C. or preferably H.N.C. and be age 22 or over.—Full details of past experience and present employers should be stated in strict confidence to BOX D 398, Offices of ENGINEERING.

ASSISTANT CHIEF ENGINEER

THE CO-OPERATIVE WHOLESALE SOCIETY, LTD., invites applications for the position of ASSISTANT CHIEF ENGINEER (MECHANICAL) in their ENGINEERING DEPARTMENT AT MANCHESTER.

Necessary qualifications are the ability to control a large staff of skilled technicians dealing with Refrigeration, Heating and Ventilation, Boiler Plant, Lifts and Materials Handling and Factory Plant Layout, and to co-ordinate the large contracts handled by these Sections.

A specialised knowledge of the work of one of these Sections, and a general knowledge of the whole is essential.

The applicant should be at least an Associate Member of one of the major professional Engineering Institutes and be able to demonstrate drive, imagination and leadership. The position is pensionable.

Applications stating full details of age, education, qualifications and experience, should be addressed to:—

The Central Labour Department,
Co-operative Wholesale Society Limited,
1 Balloon Street, Manchester 4

endorsed "Assistant Chief Engineer—Mechanical," to be received not later than 25th NOVEMBER, 1960. D 405

DRAUGHTSMEN

Draughtsmen having specialised experience in transmission, hydraulics, earth-moving and construction machinery, electric motors, or switchgear, are invited to make application for positions which have been created by a vigorous expansion programme. Positions will carry attractive salaries, and offer scope for advancement in a progressive Company. Modern offices and canteen facilities.

Please give full details of age, qualifications and experience in chronological order to the SECRETARY,

BRITISH JEFFREY-DIAMOND LTD.,
STENNARD WORKS
WAKEFIELD D 413

ASSISTANT ENGINEER

ASSISTANT ENGINEER, AGED 28/35, required at large **NORTH EAST COAST BREWERY COMPANY.** The successful applicant will be directly responsible to the Chief Engineer for the maintenance of brewery and bottling plant and to assist in the planning and installation of new plant. Applicants should preferably have had previous experience with brewery plant and maintenance, but this is not essential. Applicants should also be members of a recognised engineering institution.

Applications, which should be made in writing, should give details of technical training, practical experience and positions held and should be addressed to BOX D 407, Offices of ENGINEERING.

ADVERTISEMENT RATES

'Engineering' Appointments Section

CLASSIFICATIONS: Public Appointments, Appointments Open, Appointments Wanted.

TYPES OF ADVERTISEMENTS:

(a) "Appointments Illustrated" and illustrated careers advertisements: photographs or drawings may be used in conjunction with type matter.

Rates per page: (12 in. by 9 in.) £100
half page £54
quarter page £29

(b) Semi-display: type matter, with or without surrounding rule, name block or symbol.

Rates: per page (12 in. by 9 in.) £100
half page £54
quarter page £29
single column inch .. .. £2 14s.

(c) Single column "run-on" advertisements: approximately 6 words to the line, 12 lines to the inch.

Rate per line .. .. 4s. 6d.
(Minimum charge 18s.)

SERIES DISCOUNTS: 5 per cent. on 6 insertions; 10 per cent. on 13; 15 per cent. on 26; 20 per cent on 52.

BOX NUMBER: 2s.

Company Meetings

Quarter page, £29; half page, £54; full page, £100.

COPY DATE: First post Monday.

BLOCKS: To be mounted ready for printing. Screen 100.

ORDERS TO: "Engineering" 36, Bedford Street, London, W.C.2. (Telephone TEMple Bar 3663)

Companies

Every Corporation A British Broadcaster

ENCOURAGEMENT for local civic interest, for regional activities, and for the manufacturers of radio bradcasting equipment all flow from the PYE Company's plan for some 100 local broadcasting stations in Britain, more or less one for every town of any size, using the medium and very high frequency wave bands.

Arguing the case in *A Plan for Local Broadcasting* in Britain, Pye make the point that the wave of television development has now passed its highest level and sound radio turns out still to be there, a diminished force but one of continuing importance.

It is worth adding that there appear to be trends in mass television broadcasting systems to gravitate, more or less swiftly, to a lowest common denominator, giving the local and particular event increased significance.

VHF at Night

The Pye proposals appear to be in some recognition of this since it is envisaged that the local stations would put out news, information and features on local activities. Advertising would be a possible source of revenue, but it does not follow that the stations should be commercial in ownership or control.

The key to this sort of scheme is the availability of channels of communication and Pye's plan deals with this with considerable ingenuity. It is suggested that much of the medium wave band is empty during the day and that some 90 of the 121 medium wave channels are not used. Taking only ten of these would allow for services from 100 stations at least. For night broadcasting, when the medium band position changes materially, Pye propose that town stations should transmit in the vhf wave band.

After the availability of the channels comes the question of cost. Pye figures give the total cost, transmitters, studio, rooms and offices and ancillary equipment, for putting a station on the air to a town of 100,000 people at between £15,000 and £20,000.

Company Stations

This is not a level of outlay which would be beyond the means of local newspapers. Since it might be a development that could make inroads into the circulations and advertising revenues of papers drawing their readers from the area covered by a local station it is obvious that there are good reasons for local newspapers to spread their interests to include the stations.

But there are the local theatres or universities or even the education authorities who might appear as applicants to run the stations. And beyond them is an even more fascinating prospect.

Where a motor firm, a steel works or a shipyard is the employer of a substantial part of a town's wage earners, might not a lively direction of the local station come from the company's local executives—or even the union branch committee.

ITA Plans for Extended Coverage

The annual report of the Independent Television Authority provides an exact indication of just how much room is left by at least commercial television to local coverage by sound radio.

"Regional companies supplemented the national news service with local bulletins, whose total duration in most regions was more than an hour a week," says the report.

The authority still has some way to go in completing the full coverage of the British Isles. Steps towards future stations are being taken in West and North Wales, West Ulster and in certain other "gap" areas such as Bedford and Peterborough, Oxford and Swindon, Hereford and Gloucester, Grimsby, Boston and Skegness, Scarborough and Bridlington and Caithness and Orkney.

For North and West Wales it was found that there was no possibility of serving the area from Pembroke in the west up to Anglesey in the north from one transmitter. It has been decided, subject to the approval of the Postmaster General, that the service can be provided for the 700,000 people concerned, by medium and lower power units, one on the Prescelly mountains covering Pembroke as far as possible and a coastal belt up to Barmouth and a lower powered transmitter on the Lleyn Peninsula covering the peninsula, Anglesey, Bangor and the northern coast of Cardigan Bay. Service to the area is expected to begin at the end of 1962 or early in 1963.

Gap Areas

The best method for West Ulster, including Londonderry, is believed to be by a medium power station near Strabane using a directional aerial radiating its maximum power to the north and south. Some 250,000 people would be covered by such a station. Service in the area should be beginning during 1962.

Among the problems of filling in the service to cover the "gap" areas was the particular difficulty of Oxford and Swindon where a suitable channel is lacking.

The engineering expenditure of the authority in the financial year up to the end of March was £828,669 of its total revenue expenditure of £1,362,084. Just over £400,000 was spent on the lines network.

Thirty-Five Years Of Hire Purchase

It is not often that a voice is raised in praise of the credit restrictions imposed last April. But the chairman of the Astley Industrial Trust, Sir Stanley Bell, having in his annual review a year ago referred to the dangers of the competitive business then current with small deposits and lengthy repayment periods, is able to report that the restrictions brought a welcome respite from unfavourable terms for this trade.

While most of the leaders in the hire purchase business were able to avoid what the Astley chairman calls the "pitfalls" of the more competitive period, losses from defaults were heavier than for many years past.

Dealing in every type of hire purchase, the Astley capital and reserves have grown from £10,000 to £6 million. The advances have increased from £94,000 to £25 million, in the 25 years since the company was founded in Manchester.

The company has an engineering subsidiary, the STANDARD RAILWAY WAGON Company. Along with the others in its fields, Standard Railway met trading difficulties during the year but the chairman reports a considerable increase in the demand for rolling stock and expects satisfactory profits from this subsidiary this year.

Despite the current hire purchase restrictions the figures for the group show that the volume of business is beginning to expand again, leading to hopes for satisfactory progress, given reasonable trading conditions.

A Partnership Base on Friction

A new company, MORGAN-MINTEX, manufacturing sintered friction materials, has been formed by the MORGAN CRUCIBLE Company and BRITISH BELTING AND ASBESTOS Limited.

The sintered friction materials of the company are to be sold under the trade name "Sinterlink." Manufacture is to

Tractor fitted with Sinterlink Plates.

be carried on at the Wandsworth, London, SW18, factory of Morgan Crucible's and sales will be handled by the Mintex division of British Belting and Asbestos as sole concessionnaires.

Sinterlink is described by its manufacturers as having special application to cases where clutches are subject to heavy loading and arduous working conditions. The types of equipment in which the heat dissipation and the physical and mechanical properties can be fully realised include crawler tractors, marine and diesel locomotive reversing clutches, excavators, steel manipulators, fork trucks, automobile automatic transmissions, coal cutter-loaders, cranes, dumpers, lorries, coaches, compressors, guillotines, shear-presses, draw presses and planers, borers and lathes.

Full Reorganisation

Morgan Crucible, which now employs more than 7,000 people, has been established for more than 100 years. It has ten British factories and 12 overseas subsidiaries. Carbon products, refractories, resistors and electric heating elements, plumbago crucibles and furnaces are among the Morgan products. The last phase of the post-war reorganisation scheme for the company will be reached next April when the Morgan Crucible company becomes a financial holding company.

British Belting and Asbestos, with its main factory at Cleckheaton, Yorkshire, has been in existence for over 80 years. Manufacturing a range of asbestos textile products, British Belting also produce industrial belting, among them fire-resistant coal conveyor belting. The new sintered friction products joint company will have the benefit of using BBA's world-wide organisation of marketing companies and agents.

Marine and Road Transport —Better Thornycroft Year

With its interests divided between two main activities, small shipbuilding and ship repairing and specialised road and off-road vehicles and medium speed diesel engines for industrial and marine use, the JOHN I. THORNYCROFT Company faces special difficulties in both.

The shipping interests, owned by the parent company, are carried on at Woolston and Northam yards, Southampton, and at Southampton Docks. There is also small yacht and boat building at the Hampton yard on the Thames and in Singapore. The annual report of the chairman, Mr. John W. Thornycroft, recalls that the Southampton organisation had a successful year but bearing in mind the risks run and the capital employed it was not possible "to retain the margins of profit that were deserved."

Although the overheads have been reduced at the Hampton boatyard a loss was made during the year. Due to the high level of employment in the area it has been impossible to increase the labour force although more attractive bonus schemes have been brought in. Increased turnover at the yard is described as essential.

A New Hull

For the future a multi-purposed "V" bottomed hull is under development as an addition to the standard range of glass fibre types. The new hull is capable of being powered by outboard motors. The Singapore branch has a number of launch orders in hand and the repair section has been busy. Turnover has been reduced by labour troubles leading to a three weeks strike.

The diesel engine and special vehicle interests are owned by TRANSPORT EQUIPMENT (THORNYCROFT) Limited, a wholly owned subsidiary. This company's orders in hand were worth 90 per cent more than at the beginning of August last year. The increase is principally due to export orders. A good deal of subcontract work is also being undertaken and it seems that the amount of this work that can be handled is only limited by the available labour force.

Labour Relief

Labour supply has been a serious problem at both Basingstoke, Hants., and Reading, Berks., the two factory centres for the company, since the ending of the Second World War. The end of National Service and the plans to expand Basingstoke's population give the company some hope that these difficulties will come in time to an end.

The overall group results are slightly better than those of the previous year but a small loss still appeared in the accounts. After interest from investments there was a small profit before tax.

The GWB Powermaster Packaged Boiler

For the third Product Profile ENGINEERING has chosen for analysis that promising piece of industrial equipment, a packaged boiler.

THE packaged boiler considers the customer. Unlike its grandfathers the Lancashire and Economic boilers, it does not exasperate him by asking him to do his own plant layout, to order all the components from a number of different suppliers or to undertake substantial preparatory and building work.

The packaged boiler only requires coupling up.

Why can the packaged boiler do this while its grandfathers cannot? Basically because it is oil or gas fired.

The packaged boiler is, in fact, a natural example of a prize that can be won by anyone with sufficient imagination to see the indirect consequences of a simple technical change. In this case the change was simply that a boiler was designed around an oil burner instead of a coal-burning grate.

The packaged boiler has only appeared in this country during the past decade. For some years prior to its introduction over here surprisingly little development had been taking place in the art of raising steam for industrial purposes.

Up to 1954 if you wanted to purchase a boiler anywhere in the output range of, say, 500 to 22,000 lb of steam per hour, the most common practice was to purchase a shell from the boiler maker, complete with mountings if you were lucky. The rest of the equipment you had to purchase separately and add yourself; this would include such items as feed pumps, level controls, oil burner or stoker, and any other items necessary to make up a complete unit. Over and above this there would be erection costs; consider the Lancashire boiler, for example, with its brick setting, to say nothing of the total space it would occupy in the boiler house. The advent of the packaged boiler has altered all this.

American influence is directly traceable in the evolution of the packaged boiler. Fire tube and water tube units were in quantity production over there in 1947, and although a few were made in Britain soon after 1950, it was not until GWB Furnaces Limited introduced the Powermaster design from America in 1954 that British industry started to sit up and take notice. Since then, the idea of making a boiler a standardised shop-assembled unit mounted on a rigid base with all its auxiliary equipment has revolutionised the conception of steam generation in the applicable range.

To consider the early history of the Powermaster we must therefore turn to Reading, Pa., in America, where the firm of Orr and Sembower were constructing boilers on a base complete with pumps or similar equipment, prior to 1900. These are generally considered to represent the earliest packaged boilers in any form. Over the years they made boilers of many kinds, sometimes putting them on bases and sometimes not.

During the Second World War they turned out a large number of small packaged boilers for the American forces. As soon as hostilities ceased they seriously set about the task of designing a really top line packaged boiler that would sell in large numbers, and this went into production somewhere around 1946 or 1947.

About 1950 Orr and Sembower introduced the Powermaster, and this for the first time incorporated the Voriflow medium air pressure burner. This burner is unquestionably one of the finest heavy fuel burners in the world, and the result of its inclusion in a packaged boiler spelt immediate success for the Powermaster. Today the firm hold a large percentage of the total packaged boiler business across the Atlantic.

Orr and Sembower's association with GWB began in 1953. At that time the Boiler Division of GWB were mainly concerned with Autolec electrode boilers. Acute need was felt for the development of an entirely new product, and the two avenues being actively explored at that time were the heat pump and the packaged boiler. The packaged boiler was considered to be the more promising of the two; and in May of that year Mr. T. Allen, director and general manager, and Mr. J. A. Tatem, manager of the boiler division, visited the United States to investigate the possibility of getting a licence. They contacted Orr and Sembower, only to learn that Mr. F. H. Klein, the company's president, had himself just returned from a visit to England in an unsuccessful attempt to find a boiler firm willing to manufacture the Powermaster under licence over here. Needless to say, a marriage was soon arranged, and on completion of the licence agreement GWB built their first packaged boiler in less than four weeks in order to have it on show at the British Industries Fair in May, 1954 (Fig. 1).

Fig. 1 Prototype on show at the BIF, 1954.

Makers of the conventional Lancashire and Economic boilers were frankly sceptical of the prospects of the newcomer. It was argued that burning heavy oil in the combustion volumes that GWB were considering was a sheer impossibility; as also was having modulating burners of heavy fuel oil that required practically no cleaning or attention. Doubts were also expressed as to the life of a packaged boiler, which seemed so light in construction.

It was not long after the first Powermaster

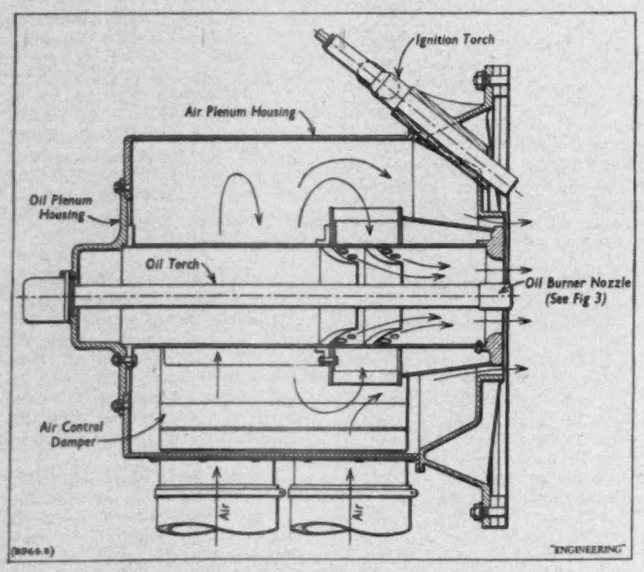


Fig. 2 (Left) Oil burner assembly. For burning gas, the oil torch and oil plenum housing are replaced by a gas inlet.

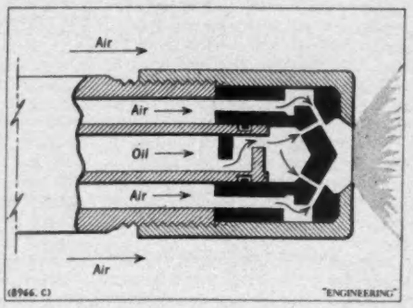


Fig. 3 (Right) Details of oil burner nozzle.

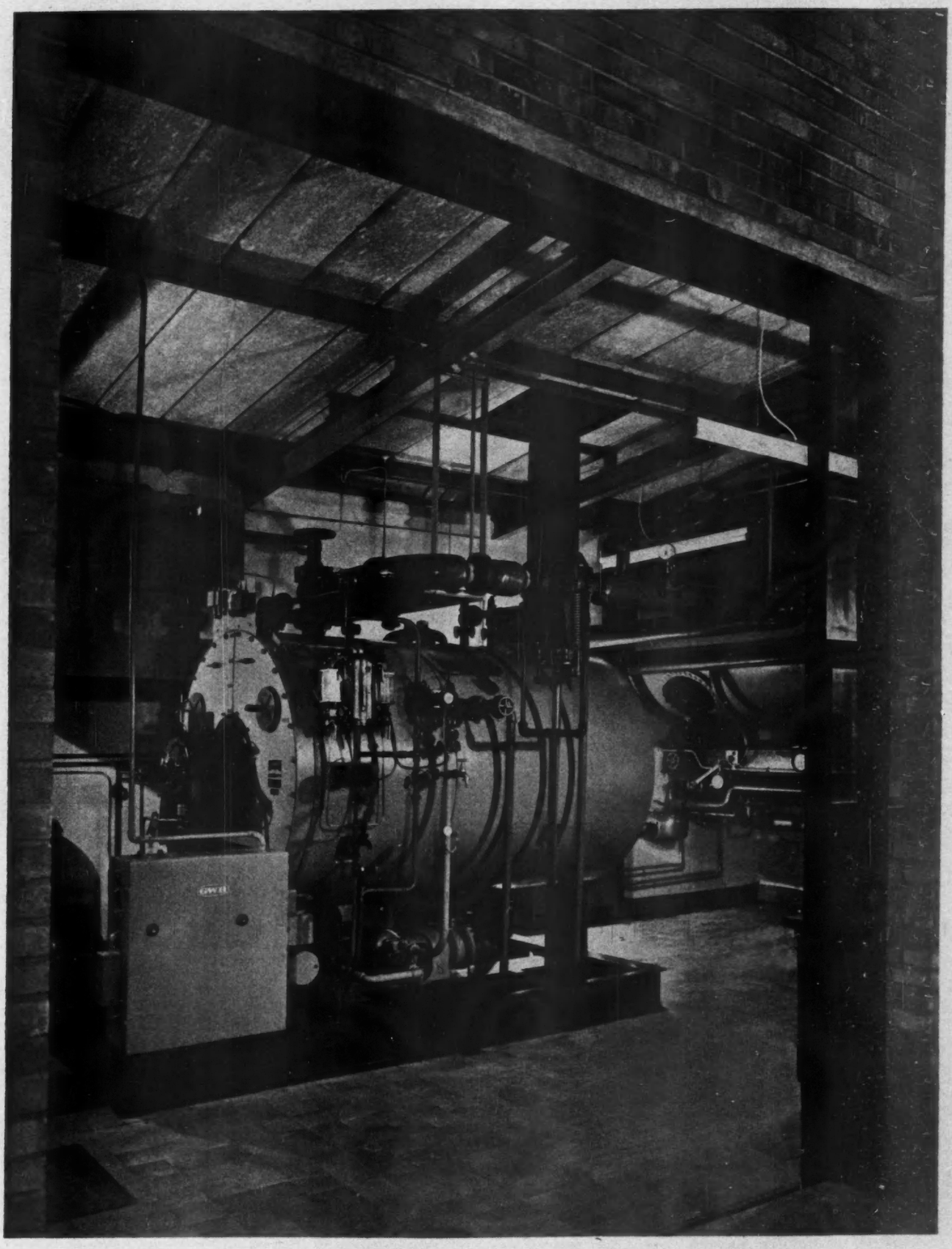


Fig. 4 Suddenly an old idea blossoms into a commercial proposition.

units went into service in Great Britain that other boiler firms started adding packaged boilers to their range. Due to careful protection by patents, however, the Voriflow burner remains the sole preserve of GWB.

Other features have also contributed to the Powermaster's success. The automatic and safety controls fitted as standard on every unit are excellent, both in the degree of remote control provided, and in the standard of reliability attained. This equipment is actually designed and made by one of the other two divisions of GWB, the Control Gear Division, at Dibdale Works, Dudley, Worcestershire, only a stone's throw from Burton Works where the Powermaster itself is assembled.

Apart from sheer economics, one of the main points in favour of the packaged boiler is the ability to give each unit a thorough trial under specified conditions of feedwater and fuel in the works. In the Powermaster, GWB have brought works testing to a fine art. This, coupled with an exceptionally detailed set of literature supplied to each customer giving him full installation, operating and maintenance instructions, minimises the chance of complaint.

Another advantage to the customer is that on a packaged boiler all the ancillary equipment is the responsibility of the one supplier. To simplify the tracing of faults and to reduce the demands on their service staff GWB have systemised the labelling of every component on the boiler by means of transfers. The wording on the labels corresponds exactly with that in the instruction book and this, in conjunction with a comprehensive fault finding chart, often enables a customer in trouble to find his own remedy. Advice by telephone is freely given.

A paramount consideration when choosing between a packaged unit as opposed to any other type of boiler is the question of feed water treatment. In order to get the highest output from the smallest practicable unit, there are small clearances between smoke tubes which are prone to blockage if scale is allowed to build up. Although the benefits of water treatment in terms of heat transfer apply to all boilers, for efficient operation of the packaged type such equipment becomes essential, regardless of the quality of water in the district. GWB therefore make a point of including in the customer's literature a booklet outlining the benefits of water treatment.

A useful optional facility offered by GWB is that of a two to three day course for the customer's boiler operator. GWB provide this free of charge, the customer paying only for the man's bed and board while he is away from home. He is trained on the actual unit of which he will ultimately be in charge.

The Powermaster is similar to its American counterpart. The chief difference is that to comply with British standards and insurance companies' recommendations, some of the scantlings had to be increased, hence the GWB Powermaster is somewhat heavier. Teething troubles were generally confined to the control gear and these have all been overcome. Larger units have been added to the range, which now comprises 17 models with outputs of from 517 to 20,700 lb per hour. Each unit can be arranged to deliver steam up to 250 lb per sq. in pressure; or supplied as low, medium or high pressure hot water boilers, either flooded or with steam space. Suitable oil fuels range from diesel oil up to 3,500 sec Redwood No. 1 in all but the smallest sizes; or town gas may be used. Alternatively, an oil/gas combination can be burned.

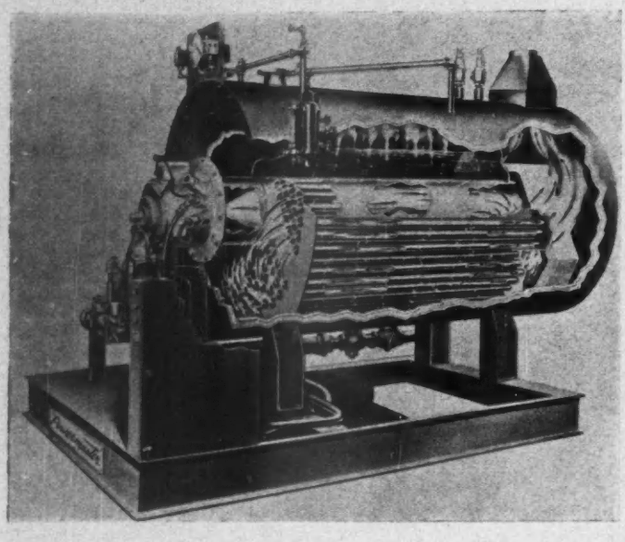


Fig. 5 (Left) Cutaway of a Powermaster. Nowadays the central fire tube is corrugated, not plain as shown.

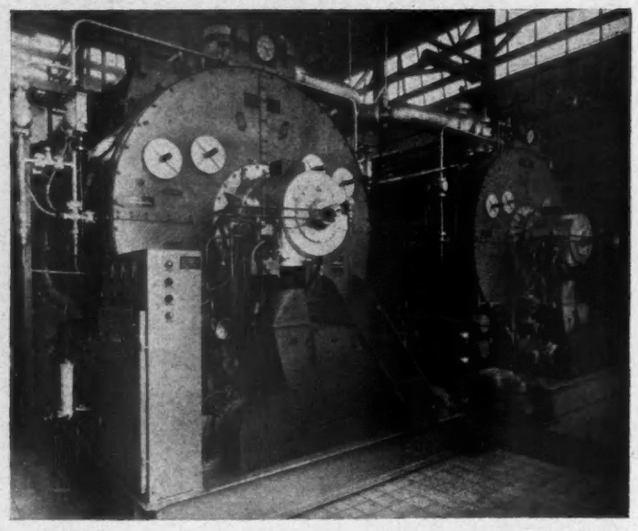


Fig. 6 (Right) Two 13,800 lb per hour units. Oil preheaters and control cubicles were positioned specially.

Fig. 5 shows the general layout of a Powermaster. The boiler is of the three-pass dry back type, complete with all ancillary equipment. The flue gases first pass to the rear of the boiler along the central horizontal fire tube, thence to the front of the boiler and back to the rear by means of batteries of smoke tubes. Electric welding of the rolled plates which form the shell, together with the tube plates, is carried out on a machine of GWB's own development.

At the rear is a door carried on a davit so that it may be unbolted and swung clear to give access to the smoke tubes for cleaning. The front cover is made in two sections and is also removable for maintenance purposes, although this is not considered a routine task.

The Voriflow burner is of the air atomising type, but the quantity of air required for atomisation amounts to only about 1 per cent of the total full load combustion air. Yet another important attribute of this burner is the range over which effective control can be maintained. On all except the smallest units a turn-down ratio of 5 to 1 is claimed, in other words the burner will adjust itself over a load range of 20 to 100 per cent. Control of the boiler is of course possible below 20 per cent, but the burner then fires intermittently. The turn-down ratio can be greater than claimed, and on the larger units as much as 7 to 1 has been realised. Fuel tank and pump are provided on oil burning installations. Gas-electric ignition is fitted.

With the Powermaster an overall efficiency of 80 per cent is guaranteed over the modulated range, and at full load this can reach 86 per cent.

In order to give an even temperature gradient along the fire tube, Powermaster units are designed so that the flame length is approximately two-thirds that of the tube. This ideal condition is dependent upon the draught created by the customer's chimney. Optimum draught at the boiler exit is in the region of 0·05 in water gauge, a low figure which can easily be exceeded if the flue conditions are incorrect. The effect of too much draught is that the flame becomes too long, and damage to the refractory lining on the rear door may result.

GWB in their pre-installation instructions recommend the provision of a draught stabiliser in the flue to keep the induced draught close to the optimum value, and this is a good practice which is to be recommended for any make of packaged boiler. A negligible draught requirement at the boiler back end has the advantage that in extreme cases the Powermaster will perform perfectly satisfactorily with no chimney.

Nearly 900 Powermasters have been produced, each built to an order. Unilever Limited are one of the main users and have installed about 30, along with other makes, both at home and abroad. The comprehensive instructions supplied with each boiler are particularly valuable for overseas installations, although final choice of manufacturer often depends as much on delivery time as on any other single factor.

After about a year of selling Powermasters, GWB decided to send to their first 50 customers a questionnaire, inviting constructive criticism based on the behaviour of the units they had purchased. No less than 47 responded, and it was at once apparent from their replies that the Powermaster, and with it the basic conception of a packaged boiler, was a winner.

The past six years have seen the acceptance and establishment of the oil and gas fired packaged boiler, and it is becoming more evident that a unit for burning solid fuel is needed. Afterwards, the production of one that will burn a combination of any two or three fuels will be relatively easy. Thus the man who wants to burn coal will be able to do so and still have a clean, labour-saving and economical boiler house.

Computer Used to Study the Human Eye

A programme of research into the mechanism of depth perception of the human eye is being carried out at the Bell Telephone Laboratories in the USA. The experimental work is being based on a new study technique which involves the use of "random" dots and stereoscopic viewing devices.

An electronic computer is used to produce "spatter" prints which, when coupled in pairs and viewed through stereoscopic glasses, are found to have depth patterns. These unusual and sometimes unexpected depth effects are revealing a good deal of information on just how the human eye and brain determine depth in normal vision.

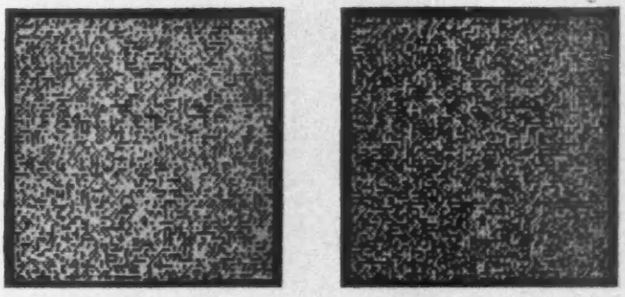
The way in which a human observer establishes the correspondence between shifted points, even when the left and right pictures differ considerably, is a key problem in depth perception. However, experiments in this field are extremely difficult to interpret. People are so accustomed to perceiving depth under familiar conditions that it occurs too rapidly for accurate experimentation.

A research worker at the Bell Laboratories developed the new stereoscopic study technique, in which two artificial pictures are created by an electronic computer and projected as a series of dots on to a television screen. These are then photographed, and the pictures viewed by a human subject through a stereoscopic viewer.

The pictures are composed of 10,000 "random" brightness dots formed into a square. Looking at this unfamiliar material slows down the mental process so that the predetermined depth effect appears gradually. This slowing down enables the experimenters to separate effects which ordinarily occur almost simultaneously.

Once a depth pattern is perceived it is remarkably stable, even when one of the picture fields is distorted considerably. For instance one field can be defocused, mixed with "noise," or changed in size, without seriously degrading the depth effect.

Work on this aspect of vision began during an attempt to teach a computer to find parallax shifts automatically—in other words, to "see" in three dimensions. Topographic map-making could be simplified if elevations could be computed from aerial photographs electronically.



A computer is used to create two apparently random patterns of dots. When viewed stereoscopically, these pictures reveal unusual depth patterns.

Annular Combustion Chamber of Free Piston Gasifier

During the past ten years or so, a fairly intensive amount of development work has been carried out on the well-known GS 34 gasifiers. The many problems in the design of the most critical component, the central annulus of the combustion cylinder, were discussed in a paper "An Experimental Study for an Annular Combustion Chamber for a Highly Supercharged Two Stroke Engine—The Case of a Free Piston Gas Generator," by a French engineer, M. A. Moiroux. This paper was recently translated and abstracted in the *Journal of the British Shipbuilding Research Association.*

The author points out that since no appreciable cooling of the scavenging air occurs after its compression (to about 57 lb per sq. in) the average cycle temperature is high (about 2,010° F). The high scavenging pressure causes violent turbulence in the combustion cylinder; this improves combustion but also increases heat transfer to the wall. The temperature of the internal face of the annulus is about 930° F.

The resulting thermal stresses may be considered constant at given power; they produce compression in the inner and tension in the outer regions of the wall. The stresses due to internal pressure are essentially cyclic and tensile. Stresses are also imposed which depend on the method of attachment, and there are local stresses due to design details, particularly the bossing and screw threads for the six injectors.

The first phase of the development was concerned with the choice of a suitable material for annuli of a design provisionally adopted; in this design the liner connections were made by studded flanges at the end of the annulus and, to save weight, depressions were formed in the outer surface, between the injectors. A heat treated steel of type 35 CD4 gave good results in severe gasifier tests and was used in the first commercial versions. However, longitudinal fractures sometimes occurred in service; these followed the centre line of a depression and were fatigue failures starting at corrosion pits on the water side.

The second phase of development involved redesign of the annulus to reduce stress concentrations and eliminate the high thermal inertia of the flanges, and the trial use of a material with greater corrosion resistance (stainless steel 56 T5). The new design had a thinner wall without depressions or flanges; the end joints were made by separate two-piece connecting rings. The cracking and corrosion phenomena observed in annuli of this type, both of 35 CD4 and 56 T5 are discussed by the author; the most significant features were corrosion fatigue and creep (which leads to a considerable reduction in the thermal stresses).

No corrosion was observed on stainless steel annuli, while that of 35 CD4 annuli was strongly influenced by the water treatment. It was concluded that the new design was basically satisfactory, but that the local stress concentrations should be more closely investigated.

The third development phase consisted of stress measurements, using strain gauges and brittle lacquer, on annuli (*a*) after the injectors had been screwed in and tightened, and (*b*) on the subsequent application of internal pressure. The results, presented in graphical form, show the stress concentrations of the bossings.

Automatic Gauge and Tension for Tinplate

A system of automatic gauge and tension control which means the production of a more consistent tinplate product and a reduction in off-gauge material, has been developed by the electrical engineering department at the Ebbw Vale Works of Richard Thomas and Baldwins Limited.

The system has now been in operation on the five-stand cold reduction mill at Ebbw Vale for several months and has been accepted as a reliable aid to mill stability by both management and operating personnel.

Instructions to improve the control of gauge on the five-stand mill were issued late in 1959. The first stage was to eliminate the well-known inaccuracies that arise from the use of a contact micrometer on high speed mills, and to do this an order was placed for an X-ray thickness gauge.

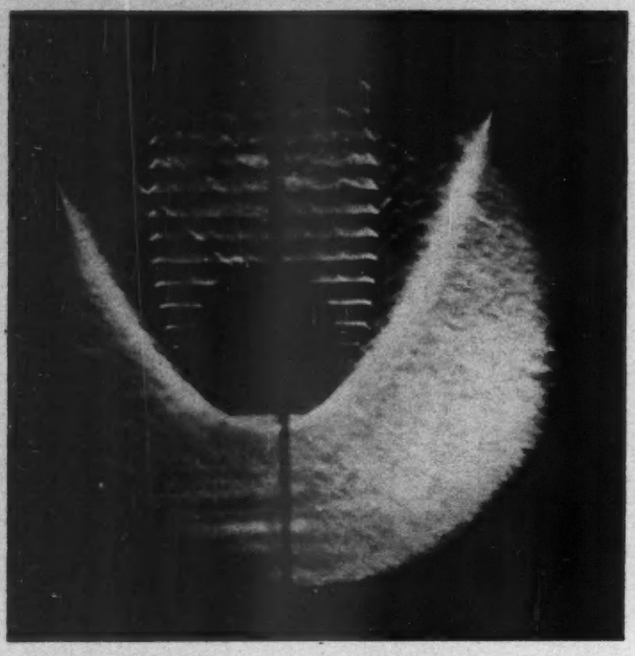
In addition, a study was made of some of the automatic gauge control systems manufactured and in use on other plants. These were all found to be extremely complicated as well as calling for expenditure of very large sums of money. Further, they had the disadvantage that they were based on a scheme of rolling which differed from that being used at Ebbw Vale. Thus, if automatic gauge control of the conventional type was introduced, it would mean that, should it fail, the operators would have to revert to an unaccustomed method of manual rolling.

With this in mind, Ebbw Vale electrical engineers developed a gauge sampling system initiating correction by means of pulses. The control covers a total range of $\pm$ 10 per cent of a preset gauge, and of this an inner "dead band" covers an adjustable area from 1 per cent to 2 per cent and this is the area within which no control is needed. The control is then applied to correct errors in gauge up to the limit of $\pm$ 10 per cent. Beyond this range, it is considered that the mill set-up is likely to be faulty, and the equipment then cuts out automatically and an alarm is given so that the set-up can be brought within range by manual means.

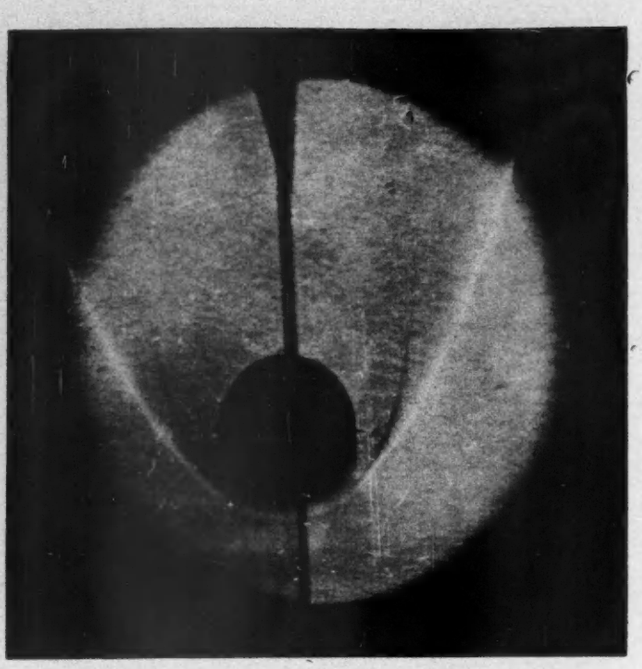
The circuitry is so arranged that the length of each individual correcting pulse is a function of the error signal, in that the larger the error the longer the correcting pulse, while the overall pulse time can be preset to the desired value which will give the maximum correction without instability. The adjustment of the space time between pulses is also possible and can be preset to allow the correct sampling time.

The automatic gauge control was installed in March, 1960, and has been in satisfactory operation ever since. Apart from a definite improvement in the amount of off-gauge, this equipment, together with the X-ray gauge, has given a very much more consistent product.

Further development work is now in hand to simplify the pulsing amplifiers used in the control system. They are being redesigned to incorporate transistors as a form of contactless switching, replacing the conventional valves and relays and thereby providing a static control system.



Large amplitude oscillations in the megacycle frequency range were observed with the test missile moving at a Mach number of 4·9.



With the test missile moving at Mach 5·53, the schlieren photographs showed laminar combustion—believed to be the first observation of this phenomenon.

Combustion Study at Supersonic Speeds

Combustion processes in supersonic streams, and in standing detonation waves, have a considerable bearing on hypersonic propulsion, both for aircraft and missiles. A new study technique has been developed in the USA.

RESEARCH engineers and scientists of the combustion controls group of the United States National Bureau of Standards, have recently devised, with the support of the US Navy and the US Air Force a new technique for securing information on combustion processes at supersonic speed.

This new method of study involves firing a missile at hypersonic velocities through a combustible gas. High-speed schlieren photography is used to obtain data concerning shape and detachment distance of the shock wave, gas density, and other effects. These data are evaluated to derive information on the combustion process in the vicinity of the missile and the above photographs were taken at an absolute pressure of 0·25 atmosphere.

PRECISE CONTROL

By using this technique, it is possible to achieve precisely controlled variation of such parameters as pressure, temperature, fuel, and speed over a wide range under realistic conditions and at very little cost. It can be employed to examine in advance some of the problems of stabilising detonation on a stationary object in a moving combustible mixture. If the wave can be established at the front of the missile, the drag will be substantially reduced.

Results of studies using this method might be applied to the generation of thrust by burning at supersonic velocities either on the exterior of a missile or within it. Also, the method should contribute to the design of flame holders for supersonic combustion.

During the investigation, laminar combustion in a supersonic stream was observed for what is believed to be the first time. An unusual occurrence was that of large-amplitude oscillations in the megacycle frequency range produced by combustion at the front of the missile.

The study of the combustion process in standing detonation waves and in supersonic streams is of great practical importance in the field of propulsion of hypersonic missiles and planes. Extensive information obtained in tube experiments is available concerning moving, plane detonation waves, but this body of data cannot with any assurance be simply transposed to the converse situation of a moving gas and a stationary oblique wave on a solid object. Furthermore, the object itself may exert unforeseen influence.

Some information has recently been obtained on the action of both normal and oblique shocks in inducing combustion in closed ducts and in free jets. The results are somewhat ambiguous, however, because of fuel and air mixing problems that exist in streams at high speed and temperature. Also the range of experimental conditions was limited by difficulties encountered in attempting to produce high-speed streams at high stagnation temperature and pressure.

The Bureau's new technique overcomes these obstacles by creating conditions such that a shock wave is established ahead of a high-speed missile, and then determining the conditions required to induce combustion and observing the effects of the missile on the combustion process. The stagnation temperatures attained are realistic, and the results are not affected by the method of mixing air and fuel or by turbulence. The experiment can easily be modified to determine the effects of the temperature and pressure history of the combustible gas on the combustion in the shock wave.

The experiments were performed at Mach numbers from 4·2 to 6·5 in a mixture of hydrogen (30 per cent by volume) in air. Combustion was initiated by means of compression and heating within the shock wave standing on the missile. Characteristics of the combustion process depend strongly on the Mach number and on the state of the gas ahead of the wave.

The experimental apparatus comprises three essential parts: a gun and a range that contains the missile and the test gas, an electronic time-delay-ratio generator that computes the time to fire a high-voltage flash lamp, and an optical system for schlieren photography.

In the experiments up to the present, 0·785 in diameter nylon spheres were used as missiles. The sphere is mounted in a 20 mm case containing a fast-burning gunpowder and fired from a 0·60 calibre, 6 ft long test barrel through a blast chamber and the test section to a heavy metal target and trap. Two phototubes are located upstream of the test gas, which is isolated from the remainder of the system by two plastic diaphragms.

Elapsed time of flight of the missile between the two phototubes is measured by an electronic timer that counts the number of pulses from an oscillator operating at a frequency of one megacycle. Signals from the phototubes enter the time-delay-ratio generator, which computes the time of arrival of the missile at the photographic station and triggers the high-voltate flash lamp at that time. A second electronic timer measures the time between the missile's arrival at the second phototube and the time at which the lamp is flashed. Two speed measurements are thus available for calculating the deceleration of the missile in the test section.

UNUSUAL OCCURENCES

The schlieren photographs recorded by the optical system provided an opportunity to observe several unusual occurrences. When the missile was travelling at a velocity near Mach 4, separate shock and laminar combustion waves were observed at the front of the sphere. At about Mach 5, combustion was intermittent. At higher speeds, the wave shown at the front of the missile was considered to be a strong detonation wave which separated into a shock and a laminar combustion wave. At pressures of $\frac{1}{4}$ and $\frac{1}{2}$ atmosphere, combustion caused the stagnation temperature to rise in the detonation wave by an estimated 700 and 1,000° C, respectively, above the temperature due to the motion of the missile.

The frequency of the intermittent combustion at the front of the spherical missile was estimated at 0·8 megacycle. Although extremely high, this frequency is not unreasonable when one considers the ignition delay time observed in experiments where combustion is steady.

Air Intakes at Subsonic Speeds

Tests have been made at speeds up to Mach 0·93 to examine how the longitudinal characteristics of a fighter-type aircraft are affected by the installation of air intakes in the nose, fuselage sides, and wing roots. The tests were carried out at the Royal Aircraft Establishment in their 10 ft by 7 ft high speed wind-tunnel. None of the air intakes investigated were found to alter the lift or pitching-moment characteristics significantly, but their effects on external drag were found to vary; the nose intake being the only one to avoid an increase of drag.

The superiority of the nose intake derives principally from its low area ratio, the value of which largely determines not only the critical Mach number (and hence the behaviour at transonic speeds of the intake fairing) but also the sensitivity to spillage and aircraft attitude.

Both forms of divided intake cause an increase in profile drag of roughly 20 per cent; on the side intake this is due to the siting of the boundary layer by-passes, and on the wing root intake it is due to the increased wing thickness. Their high area ratios make them sensitive to changes in flow direction and lead to high suction levels over the intake fairings which are expected to cause drag increases early in the transonic range. Separation in the canopy intake junctions of the side intake reduces the drag divergence Mach number to 0·87, compared with 0·89 for the other models.

The shaping of the wing-body junction, which was combined with the nose and side intake installations, leads to a marked reduction in drag at transonic speed, an advantage not shared by the wing-root layout. A paper reporting this work, entitled " Subsonic Wind-Tunnel Tests of Various Forms of Air Intake Installed in a Fighter-Type Aircraft," by B. J. Prior and C. N. Hall, has been published by HM Stationery Office, London, at £1 1*s* 0*d* net.

Level Indicator for Liquid Helium

Tantalum becomes superconductive at a temperature that is only a fraction of a degree higher than the boiling point of liquid helium. This fact has been put to good use by scientists of the Physics department of Moscow State University in developing a level indicator that is suitable for liquid helium.

In a coil of tantalum wire the voltage drop is measured at a current of between, say, 20 and 60 milliamps. At the moment of contact between the coil and the liquid helium the tantalum immediately becomes superconductive and the voltage at the terminal of the coil drops to zero. If, as is usual, the liquid helium is stored in a metallic container then an additional constantan wire heater is wound over the coil: its heating capacity is sufficient to prevent the helium vapour from cooling the coil below its transition point but not sufficient to keep the coil " warm " when the latter comes into direct contact with the liquid helium. The indicator is reported to be accurate to within plus or minus one millimeter.

Straightening Polished Sheet Metal

A machine said to be capable of straightening highly polished sheet metal as it is continuously unwound from a coil, without in any way marking the material, has recently been designed by a German engineer. The strip moves horizontally through a succession of rollers placed above and below the plane of the metal, and so positioned with the help of back-up rollers that every part of the moving sheet is acted upon at least once. This is one advantage claimed for the device, another being that no gaps are allowed to form between the back-up rollers (a common fault with many machines) thus ensuring that the moving strip is subjected to an even pressure at all times throughout the straightening operation.

Under present industrial conditions it is often very difficult, though extremely important, to ensure that the sheet metal fed into automatic stamping and pressing machines is perfectly flat and straight. If this is not done then components of consistent quality and high accuracy cannot be guaranteed. Also, if the metal is highly polished, as for example in the case of material used for aircraft wings, it is essential for the economics of the process that the component should not need repolishing after it has been pressed. It seems likely that the machine in question will adequately satisfy these conditions.

Composition Control of Combustion Gases

A new type of apparatus developed specifically as a method of controlling the composition of air and gas mixtures supplied to multiple burners, is said to operate in such a way that the composition always remains constant in spite of the pressure changes that occur in the feed pipeline. The designers, Le Four Industriel Belge of Brussels, claim that at present no other unit is capable of providing such effective control, mainly because of the counter pressures brought into play at the burner outlet.

The control assembly is designed to operate as follows:—

A streamline flow of air enters a convergent nozzle and passes through the inner section of two short coaxial cylinders before it expands into the throat of a divergent nozzle. At the same time gaseous fuel passes into a separate chamber and through the outer coaxial cylinder before it too enters the throat of the nozzle: the parallel jets then travel the length of the divergent nozzle on their way to the mixing chamber. Control of the whole operation centres around the pressure regulator which ensures, by virtue of feed back lines, that pressures in the gas chamber and the mixing chamber are at all times equal. The ratio of gas to air must of course depend upon the cross sectional area of the respective supply lines but it is kept constant by injecting air into the mixing chamber as and when required.

Basic Research into Ceramic Fracture

A fundamental research programme to determine the basic factors that influence the fracture of non-metallic ceramic materials has been started by the Armour Research Foundation under the sponsorship of the Wright Air Division's Materials Control Department, in the United States.

This 18 month, $460,000 study, unique in its size and administrative aspects, will be conducted by a team of research workers at the Armour Foundation, and by research staffs of several well-known universities and industrial concerns in Europe and the United States.

The primary purpose of the research is to develop an understanding of the complexities involved in the fracture of inorganic non-metallic ceramics. Efforts will be made to discover why and how ceramic materials fail, and then to develop methods to improve their reliability.

The ceramic materials to be used will be subjected to such influences as various stress fields, strain rates, corrosive attack, temperatures, prior loading history, and surface active environments (e.g. neutral or oxidising atmospheres, acid vapours, etc.). A thorough investigation will be made to discover how these factors influence ceramic materials containing differing levels of impurities, various grain sizes, and with varying shapes and configurations.

Dr. N. A. Weil, director of mechanics research at the Armour Foundation and project manager for the programme, has said that the study will be principally concerned with metallic oxides, represented by single crystals and multi-crystalline forms of magnesia and alumina. In addition, titanium oxide, silicon dioxide, titanium carbide, and lithium fluoride will be explored.

Influence of Soil on Underground Cables

Every year, about £26 million is invested in underground electrical mains in England and Wales. In the majority of cases the cables involved in these investments are buried directly in the ground.

In spite of the importance of these projects, and the sums of money involved, there is still a great deal of uncertainty about the current-carrying capacity of these cables because the present knowledge of the thermal properties of soil is inadequate.

The electrical current ratings of buried cables are strongly dependent on the thermal resistivities of soils, which vary substantially with soil type,

An instrument has been developed to measure the thermal properties of soil at cable depth, without disturbing the soil.

compaction, moisture content and seasonal conditions. In order to obtain optimum utilisation of any given investment in buried cables it is therefore essential to have a sound understanding of the thermal properties of soils and to devise practical means of assessing their effects on a particular cable installation.

Research on this topic is being actively pursued at the Electrical Research Association, Leatherhead, Surrey, and two aspects of the problem have been successfully dealt with:

(1) A thermal resistivity probe has been developed and carried through to the stage where it can now be manufactured and marketed. It consists of a stainless steel probe which can be inserted into the soil at cable depth, and connected to its associated measuring circuits. The complete equipment is portable and a measurement of the thermal resistivity of the undisturbed soil can be made in about thirty minutes. By selection of appropriate test points, it is thus possible to do a survey of the thermal properties of a complete cable route.

(2) A system of soil identification has been devised to enable the physical properties of a particular soil to be brought into any design calculations before laying the cable. Known as the " ERA Simplified System of Soil Classification," it provides a means of unambiguous identification by systematic visual and tactual examination on site. It is visualised that, in due course, a useful degree of correlation between classification and thermal properties may be established through this system.

On the Shelf

By Frank H. Smith

WE TRIED to get a copy for review of the proceedings of a UNESCO conference on information processing held in June, 1959. The agents in this country replied that unfortunately there was only one review copy available for this country and that had been sent to Aslib. Here's a subject of interest to the whole of industry and one copy goes to a journal with a comparatively small circulation (no offence to Aslib). With a price of 7 guineas on its head this is a work that cries aloud for maximum publicity in journals read by executives. If you want to know more, get on to Butterworth (4-5 Bell Yard, Temple Bar, London, WC2).

The 59th edition (1961) is available from Wm. Dawson and Sons Limited, Cannon House, Macklin Street, London, WC2, of the "Little Red Book." This, as you will remember (flattery), is their *Guide to the Press of the World*, and lists every periodical you can think of and many you cannot, with a letter indicating frequency of publication and sub. rate. It starts with an alphabetical list of British, then Commonwealth (by country), then American, then furriners (is there some significance here?) by country and then a classified list of the lot.

Things like rabies and bovine tuberculosis seem to be eradicable but the noise disease is one that is likely to get worse and worse. Nevertheless, some folk are interested in suggesting means of getting rid of it and they may like to see the October issue of *Mémoires* of the Société des Ingénieurs Civils de France, which contains a colloquium on the subject. Each paper (or aspect) is accompanied by a useful bibliography.

One of the moans of those responsible for disseminating information is the difficulty of keeping tabs on university theses. Various collections are made in various forms and you may like to know of a publication of the University of Illinois Engineering Experiment Station (Urbana, Illinois) called "Engineering Departmental Reports and Theses 1958-1959." This is in their Bulletin series Vol. 57, No. 41. It is dated January, 1960, so I don't know where I've had it all this time. The February number of the same series (to which the same remark applies) is "A Summary of Engineering Research 1959."

A new departure comes from Oxford UP acting for Princeton UP. Between them they do a series on high-speed aerodynamics at a price that puts it in the library range only (unless any millionaries are interested in aerodynamics). But Princeton, with a generous gesture, have extracted the essence from some of the volumes and made it into a series of paperbacks called the Princeton Aeronautical Paperbacks. These come in a range round 11*s*-15*s* and it is worth asking Oxford about them. Besides, they make all the difference between carrying a bookshelf around and putting something in your pocket.

I usually drop a hint or two on behalf of the kiddywinkies towards Christmas: I like the look of Dent's Children's Illustrated Classics. At 10*s* 6*d* and 12*s* 6*d* the list includes a lot of the books I wish I had read when I am trying to answer Top of the Form in front of my more erudite 11-year-old. Dent have also issued their autumn and winter list, which includes Everyman Paperbacks to be issued six at a time in October and January. How long, I wonder, before rigid binding dies the death?

For a bob the Stationery Office have put out an attractive glossy booklet called "Published by HMSO." It deals, in a chatty way, with the various sections (as seen in their monthly lists) under which they publish, and it is just the sort of thing to give to an applicant for a new job to read during that awkward twenty minutes he or she has to wait while you tidy your desk and get rid of the dirty coffee cup.

Long Range Education

Teaching Through Television. By HENRI DIEUZEIDE. *Organisation for European Economic Co-operation, Paris; HM Stationery Office, London.* (5*s*)

In the introduction to *Teaching Through Television*, Dr. Alexander King, director of the Office of Scientific and Technical Personnel in OEEC, states that "as part of its efforts to help increase and improve science teaching, the OSTP felt that the current status of educational television in Western Europe should be investigated. For this purpose, a seminar of outstanding specialists in the field is planned for July, 1960, at Ashridge."

As a preparation for the seminar, which did in fact take place as scheduled, M. Henri Dieuzeide, head of the French School Television Service, conducted a preliminary study on television teaching in Western Europe. The results of his findings are included in this report, which is the first comprehensive survey ever to be carried out. It is, therefore, a valuable reference document even if some of the information is now out of date.

M. Dieuzeide is not content to give factual information. An experienced teacher and exponent of modern teaching techniques, he has put forward some of his own forthright views on the place of visual aids and television in teaching today. The report deals mainly with science teaching on television but many of his remarks are applicable to all educational television.

In Europe today, there are only three countries now running regular national schools television programmes—they are France, Italy and the United Kingdom. Experiments have been carried out in Belgium and Switzerland, and Germany (Hamburg). Netherlands and Sweden plan to start up in the near future. From existing programmes, M. Dieuzeide notes that there are two quite distinct functions of educational television in Europe—there is the background information or "enrichment" programme typical of UK production or direct teaching by television as in Italy's Telescuola, where the programmes are seen by children for whom no school facilities exist. It is probable that a middle of the road type of educational television will develop in several countries.

Some of the report makes depressing reading—evident lack of imagination in production, little use of visual aids, lack of initiative on the part of educational authorites, ill-defined relationship between television, films and radio, difficulties in inserting television into rigid timetables and the disappointingly small number of closed-circuit experiments being undertaken.

Perhaps M. Dieuzeide is a little too pessimistic and critical. It is certain that programmes in the UK have shown some imagination, good use of visuals and become increasingly popular, judging from the number of schools now viewing science programmes. He is rather unfair too in claiming that the electronics industry has done little to encourage the use of closed-circuit television in schools. Several large companies have made noble attempts to do so and if their efforts have not always met with success the blame lies not so much with them as with the schools or educational authorities which are not yet geared to this new technique.

The theme which M. Dieuzeide underlines at the end of his report is important—cooperation: cooperation between countries, cooperation with industry, cooperation between education and television. It was this theme which formed the basis of the seminar at Ashridge. Presumably the OEEC will publish a report on this important meeting between representatives of television, education and industry. It could form a useful companion volume to *Teaching Through Television.*

JEAN LE HARIVEL

Flight as Poetry and Record

The Aeroplane: An Historical Survey of Its Origins and Development. By CHARLES H. GIBBS-SMITH. *HM Stationery Office.* (35*s*)

Powered flight is currently passing through a critical phase in its evolution, both technically and in terms of its effect on human habits. This book is thus a timely and unique survey of the development of the aeroplane. It is timely in the sense that an increasing number of people throughout the world are using the aeroplane as a means of transport, without ever knowing the urge that made men want to fly in the first place. Their experience of flight—which is to be sealed up, 120 at a time, in an insulated tube, like rows of eggs half afraid of being prematurely cracked—has little in common, with, for example, sitting way out in the eye of the wind, in an open cockpit, wearing nothing but a pair of shorts and sandals, above even the birds. The book is unique in that the fabric of historical fact has been pleasingly woven with a thread of the human vision which created it.

Flying is an intensely personal thing for the flying-man and the aeroplane is much more of an artistic marriage between the dream of the designer and the hypotheses of the scientist, than the precise child of a set of natural laws. Despite the difficulties that might involve in a work of this kind, Mr. Gibbs-Smith has very successfully reappraised much of what has been said, written and claimed in the past. In doing so he has demolished several long-standing claims to fame and rearranged the order of importance of others.

The book is divided into two main parts, separated—or bridged—by an interlude of poetry and prose quotations, which usefully emphasise the importance of the human aspect and point of view in the development of flight.

The first part consists of a historical survey, beginning with the myths, the dreams and the adventurers. The point is made upon the first page that, although man had dreamed of flying from ancient times, he had to wait until science and engineering were sufficiently advanced to enable him to succeed. In this respect there is a close parallel today, when man, who is reaching for the stars, still lacks the energy to leap.

The history is entertainingly unfolded in a few pages up to 1800 and Sir George Cayley. At this point the story strides forward and we realise the worth of the man as "the true inventor of the aeroplane and one of the most powerful geniuses in the history of aviation," perhaps for the first time as we see him in the perspective that is due to him. One may speculate upon the state of the art that might have been reached in Europe if Sir George Cayley had been a younger man when, in the early 1850's, his coachman was successfully airborne during some of his experiments.

After Sir George Cayley the history leads to the present day, by way of the Wright brothers and the World Wars. The interesting period between the wars is divided. The first period was marked by the record breakers, the biplane in all its glory, streamlining and the growth of aerodynamics as a full-blooded science in its own right. The Schneider Trophy races, which began before the First World War, bred something more than a class of beautiful seaplanes—the like of which will never be seen again—it bred the first of the highly streamlined and fast monoplanes which heralded the second period, and the Second World War. The second period, from 1930, saw the decline of the biplane and

its replacement by the monoplane, the maturity of the piston engine and the birth of the turbojet.

The Second World War brought with it phenomenal changes. It began with piston-engined aeroplanes, some of them fabric covered, armed with light machine-guns and bombs; and ended with jet engines, all metal airframes and skins, rockets, heavy cannon and the atom bomb.

The post-war story shows how men have beaten the "sound barrier" and its unpleasant compressibility effects. Now man is faced with his first tentative step into outer space, when the aeroplane may reach its definitive version as an atmospheric vehicle for the carriage of passengers and freight to and from orbiting space platforms.

The second half of the book is formed by "The Commentary." It is difficult to distinguish clearly between the material in the second half and the first. One might say that it comprises bits and pieces that could have been woven into a continuous fabric, but which serve to illuminate the whole by being treated separately in greater detail. Here we find the origins of the parachute outlined, together with the aero-engine, flying control systems, and also claims and controversies. A wealth of detail is included about the Wright brothers and early aeroplanes. There is a table of the first efforts to fly and early flights, a chronology, and a useful index.

The book is attractively produced and nice to handle, but the visual impact achieved by the cover is lessened by some of the illustrations. The early historical drawings and photographs are fine, but one might have wished for better draughtsmanship in some places. If one chooses to use a drawing in place of a photograph, then it must be capable of contributing more to the text than a photograph. Admittedly, the side elevations of aeroplanes are worthwhile, but many of the three-quarter drawings do not enhance the text—or give an accurate impression of the aeroplanes. In certain cases they could have been replaced by superior existing photographs. As far as maintaining a visual effect is concerned, perhaps later editions of the book will take note of the work of some recent authors of books about aeroplanes, in which the drawings are an intrinsic part of the whole.

But this is a small criticism of a most valuable book which fulfils a real need. What adds to its attraction, perhaps more than anything else, is that it is a labour of love. In this it reflects the same quality that marked the work of those who created its subject.

D. STINTON

Astronautical Perspective

Ballistics and Guided Missiles. By ADRIAN BALL. *Frederick Muller.* (9*s* 6*d*)

Many books describe British aircraft achievements, but few mention the considerable British effort in guided and ballistic missiles, no doubt due to security, both real and imagined. This small book places the British effort in perspective with the American. Lack of factual British material weighs the scales heavily in favour of American achievements, where "no attempt is now made to keep the launchings secret and journalists representing the world's Press are invited to firings well in advance, and watch them from their own grandstand." By contrast the 1,000 missile firings a year from Aberporth, Wales, must be dismissed in a single page.

The book is written in popular style, very often in the first person singular, and opens almost like a novel. Intermediate and short-range missiles are defined but no mention is made that the British Bluestreak has been cancelled as a long-range ballistic missile, although its fate as a satellite launcher is still in the balance. Scale drawings and photographs of many missiles in this class are given. "Ground to air missiles" describes the difficulties of interception of enemy aircraft and particularly of ballistic missiles. The ground systems for detecting enemy attacks are also described, along with British, French, Russian, Swiss and Japanese missiles. Air launched missiles are treated and then followed by an account of missile production. The author then turns to ranges, both the Atlantic and British ranges.

The next chapter gives wartime uses of missiles, based entirely on the defence of the United States. The final chapter on missiles for peace is concerned, somewhat illogically, with space satellites, many of which are described, together with two possible types of communications satellites.

This well written and accurate little book has photographs of 17 missiles plus 14 pages of diagrams, but no index or appendices. Although aimed at the younger reader, it forms a very useful introduction to post-war accomplishments in missiles.

W. F. HILTON

Mixed Viscosity and Elasticity

Introduction à l'Étude de la Rhéologie. Edited by B. PERSOZ. *Dunod, 92 rue Bonaparte, Paris 6.* (44 *NFrs*)

Deformation, Strain and Flow: An Elementary Introduction to Rheology. By MARKUS REINER. 2nd edition. *H. K. Lewis.* (63*s*)

Statics of Soil Media. By V. V. SOKOLOVSKI. *Butterworths Scientific Publications.* (52*s*)

The number of combinations of elastic and viscous properties that can be exhibited simultaneously in the same material appears to be unlimited, and there is an ever-increasing number of research scientists and engineers who find themselves for the first time involved in the comparatively new science of rheology. Their primary interests vary from emulsions to glasses, from metals to petroleum, from geology to medicine. In order to meet the needs of French readers in this wide class, 15 members of the *Groupe Français d'Études de Rhéologie* have cooperated in the publication of a collective work, *Introduction à l'Étude de la Rhéologie*, edited by B. Persoz. This work sets out to introduce the subject without involving the reader in an elaborate mathematical study of theoretical rheology, and comprises two distinct parts: an account of linearised theories of elastico-viscous and visco-elastic behaviour, followed by an outline of the main features in the behaviour of some real materials of rheological interest.

The first three chapters, written by B. Persoz, present in a clear style and logical sequence the basic ideas: the essential definitions needed to describe elastic, viscous and plastic bodies (including in each case the most common departures from the ideal, classical behaviour); the mechanical and electrical analogues useful for representing various rheological responses; and the superposition principle that so greatly simplifies the study of stress-strain-time relationships, under certain restrictive conditions, in materials with a "memory" of their past rheological history.

Two further chapters complete part one. The concepts of stress, strain and rate of strain in three dimensions, with a concise account of the significance of the quantities needed to measure them and with special reference to ideally elastic, viscous or plastic bodies, are treated by J. Mandel and F. Germain. The extension to visco-elastic bodies, using Carson transforms to recast equations of state representing linear visco-elasticity at small strains into the form of the canonical equations of elasticity theory, is completed by J. Mandel.

The same high standard of clarity and conciseness is maintained throughout part two of this volume, in which C. Crussard gives a brief factual account of the plastic properties of metals; H. Saucier describes something of the rheology of glasses; A. Képès treats some solid polymers; P. Thirion, elastomers; R. Durand and H. Lafuma, aqueous suspensions of particles; F. Kauer, paints and varnishes; A. J. de Vries, emulsions; H. Weiss, petroleum products; M. Joly gives an account of the importance of rheology in biology, A. Mayer in soils and J. Goguel in geology. Here are sufficient examples of unexplained or partially explained deformation and flow phenomena to impress upon the reader the need for further rheological investigations in many fields.

Useful bibliographies at the ends of chapters in part two take the place of the searching questions for the student that are to be found after each chapter in part one. An index and a short English-French-German glossary of principal terms enhance the value, to the comparative stranger to rheology, for whom it is primarily intended, of a work that deserves the highest praise: it seems to this reviewer to achieve admirably what it sets out to do.

Markus Reiner's *Deformation, Strain and Flow* is the second, enlarged edition of an elementary introduction to rheology that first appeared under the title *Deformation and Flow*. It was based on a series of lectures, given to an audience of chemists and involving the minimum of mathematics. To the reader already familiar with modern rheology this book will be useful as providing a source of historical facts concerning the early formulation of rheological ideas. With the uninitiated after a first reading, however, it must inevitably leave the general impression that, once a material departs from the strict letter of Hooke's law of elasticity or Newton's law of viscous flow, then some very strange things indeed can happen to it. Properties described include antithixotropy, creep, cross-elasticity, dilatancy, ductility, flow-elasticity, leptogenesis, redress, relaxation, rheodestruction, rheopexy, rugosity, rupture, *Spinnbarkeit*, stickiness, strain-softening, thixotropy, wall effects and work-hardening—and where property would seem to be too precise a term, the concept of a *quasi-property* might be needed!

This author leans heavily on the use of mechanical models to illustrate by analogy the rheological behaviour of some of the better-defined idealised materials. Combinations of unidirectional springs and dashpots in parallel or in series—to represent the relationship of stress to strain, when these vary with the time, as an alternative to linear differential equations relating these variables—are now widely accepted as useful means of visualising different modes of linear viscoelastic response to stress. Extensions of models to include springs in different directions to represent cross-elasticity—the appearance of stresses in all directions when the simplest type of strain is applied—are of less obvious value. The differential equations of these extended models would seem to be no longer identifiable in form with the differential equations of state

of the idealised rheological body, and the reader is then in danger of interpreting the models in another way, as representations of the actual microstructure of the material, contrary to the author's intention.

A list of symbols used, a collection of general references to books and to papers, especially early papers, and a useful index fill the last 18 pages of a book which will surely find its place on the shelves of many rheologists. Professor Reiner's personal contribution to the development of rheology is universally acknowledged, and his views on recent advances in the theory—some of which find expression in the second edition for the first time—will be read with interest by both experimentalists and theoreticians. The author oscillates from the most elementary explanations that everyone will accept to discussions of some very subtle points indeed, and his book is valuable perhaps most of all because it will stimulate the serious student to think out for himself the answers to some questions of the moment that the second edition only draws attention to.

Is it useful to distinguish sharply *strain* and *deformation*, retaining the former term to denote only elastic or recoverable strain, and is this even a precisely defined term in the most complex rheological body? Is it useful to represent the volume changes in a material by an equation that represents a never-ending decrease in volume at every constant pressure? What explanation of the Weissenberg climbing effect in elastico-viscous liquids can one accept, and are comparable normal-stress effects really present in ordinary air at very high shear rates?

It is inevitable that some branches of rheology should develop more rapidly and with greater elaboration of detail than others. When the response to stress of a particular class of material of engineering importance can for most practical purposes be very simply formulated, and the behaviour of the material has been studied in many different situations, then specialised mathematical techniques are developed with very little possibility of application to other branches of rheology. The study of certain aspects of the deformation of soils has reached this state of independence of the rest of rheology.

V. V. Sokolovski, the author of *Statics of Soil Media*, is personally responsible for some of the most important advances in soil mechanics. In the second (1954) edition, now translated into English by D. H. Jones and A. N. Schofield, are included, among other recent developments, the fruits of the author's research on general methods of examining critical equilibrium in a cohesive medium and on the equilibrium of a granular wedge. This book gives a detailed and systematic account of the general theory of critical equilibrium and of a wide selection of problems that have now been solved, on the assumption of a two-dimensional pattern of stresses in a soil with both frictional and cohesive properties. Many practical examples are included as illustrations, presented with clear diagrams and with occasionally the results of a numerical integration of the critical equilibrium equations fully tabulated.

Solutions of problems are constructed by resolving a practical problem into simpler problems that can be solved by a canonical system of equilibrium equations. Networks of slip-lines are constructed, as in the theory of plasticity in metals—and, indeed, when intergranular friction can be ignored, the theory is closely analogous to that of plane plastic equilibrium. The stability of foundations and slopes, the pressure of a fill against a sloping or broken-back retaining wall, the equilibrium of a granular medium in a layered structure and in a wedge, stresses in embankments, and the theory of plane critical equilibrium in a purely cohesive medium in which shear stress is a general function of normal stress, are topics within the scope of the book. A bibliography that includes many references to Russian papers, among others, is a valuable feature.

Here clearly is a book that every serious student of soil mechanics should buy. It is a book that must be read through systematically, for it lacks a subject index and has too few subheadings to encourage any who have not studied it to find in it a handy reference book.

J. G. OLDROYD

New Books

The Design of Sea Defence Works. By ROLAND BERKELEY THORN. *Butterworths Scientific Publications.* (25*s*)

A detailed and mathematical treatment of the subject, for which the author has drawn heavily upon his own experience of the design and construction of works for the Kent River Board Sea Defence Works.

Engineering Thermodynamics. By JAMES B. JONES and GEORGE A. HAWKINS. *Wiley, New York and London.* (68*s*)

Intended for use in undergraduate engineering courses, this text has as its purpose the development of an understanding of the first and second laws, and some physical property relationships, together with a degree of competence in the application of these principles to engineering systems.

Stresses in Shells. By WILHELM FLÜGGE. *Springer-Verlag, Heidelberger Platz 3, Berlin-Wilmersdorf.* (58·80 *DM*)

A theoretical treatise intended for engineers, covering the membrane theory, the bending theory of the circular cylinder and the general shell of revolution, and the stability of shells.

Geometric Properties of Rolled Sections and Built Girders: Volume 1. British and USA Sections. *Lloyds' Register of Shipping.* (63*s*)

This book has been prepared for the use of shipbuilders and designers in selecting the appropriate sections for longitudinals, frames and other stiffening members as required by Lloyds' revised Rules for Oil Tankers.

Large Radiation Sources in Industry. Volume 1. Proceedings of the Conference on the Application of Large Radiation Sources in Industry and Especially to Chemical Processes, Warsaw, 8-12 September, 1959. *International Atomic Energy Agency, Vienna; HM Stationery Office, London.* (27*s*)

Papers presented at the Conference were grouped under the headings: sources and methods of use; cobalt-60 and other radiation facilities; the use of fission fragments recoil energy for chemical processing; radiation effects on plastics and elastomers; and radiation initiation of polymerisation and grafting.

The Antitrust Laws of the United States of America. By A. D. NEALE. *Cambridge University Press.* (45*s*)

An account of the working of the US antitrust laws and their value as a model for other countries faced with the problems of monopoly. The first part of the book describes the laws, the court decisions and the enforcement processes, while in the second the author analyses and evaluates the system.

The Uses of Electricity in the Oil Industry. Edited by E. A. REEVES. *Ernest Benn.* (50*s*)

This reference book for the electrical engineer concerned with the oil industry is made up of 21 contributions from specialists in oil companies, electrical manufacturing companies, and other specialist companies and organisations, covering safety problems, operational practice, equipment, and special applications of electricity in the oilfields, tankers and refineries.

International Missile and Spacecraft Guide. By FREDERICK I. ORDWAY, III, and RONALD C. WAKEFORD. *McGraw-Hill, New York and London.* (194*s*)

An encyclopaedic guide to the rockets, missiles and spacecraft of the world. The first section comprises a chronology, dating back to the use of rocket-propelled arrows by the defenders of Kai-fung-fu in A.D. 1232, and general surveys of the different types of missiles and vehicles. The second section gives an account of the current activities of each of eleven countries.

Principles of Semiconductor Device Operation. By A. K. JONSCHER. *G. Bell and Sons.* (30*s*)

The specific subject of injection, decay and transport of excess carrier densities in semiconductors is one which the author of the present work feels has previously been inadequately covered, falling between the theoretical approaches, which stop short of it, and the more applied treatments, which tend to take it for granted.

Engineering: The Profession and Elementary Problem Analysis. By H. W. LEACH and GEORGE C. BEAKLEY. 2nd Edition of "Elementary Problems in Engineering." *Macmillan, New York and London.* (37*s*)

The significant change in the title of this new edition is reflected in the organisation of the text. The three sections of the work cover the art and science of engineering, its history, potentialities, specialised divisions and professional societies; the presentation of problem solving; and applications of the engineering method of analysis.

Theory and Practice of Arc Welding. By RAYMOND J. SACKS. 2nd Edition. *Van Nostrand, Princeton, New Jersey and London.* (45*s*)

This textbook presents an original course of study in arc welding theory and practice in accordance with current US industrial practice and the recommendations of the American Welding Society. It is designed both for students in organised courses and metal workers interested in welding as a supplementary tool.

Crystal Growth: Discussions of the Faraday Society No. 5, 1949. *Butterworths Scientific Publications.* (60*s*)

Originally published by the Society in 1949, this volume of the *Discussions* has been out of print for some time. A number of valuable papers are given wider distribution by this reprint.

The Reviewers

M. Jean le Harivel, M.A., is television specialist with Shell International Petroleum Company. He was previously head of the Information and Films Service in the European Productivity Agency of OEEC.

Flight Lieutenant D. Stinton, A.F.R.Ae.S., G.I.Mech.E., joined the Royal Air Force as a pilot in 1953, completed the Empire Test Pilot's Course in 1959, and then took up duties at the Royal Aircraft Establishment as a service test pilot. Previously he had served an apprenticeship with Blackburn Aircraft Limited, where he also worked as a draughtsman. He was later employed as a draughtsman and then in the stress office at the de Havilland Aircraft Company.

Dr. W. F. Hilton is head of the Astronautics Section in the Advanced Projects Group of Hawker Siddeley Aviation Limited. He is a fellow of the Royal Aeronautical Society and the British Interplanetary Society and an associate fellow of the Institute of Aeronautical Sciences.

Professor J. G. Oldroyd is head of the Department of Applied Mathematics at University College, Swansea. A former fellow of Trinity College, Cambridge, he is a past president of the British Society of Rheology.

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Materials

Titanium Heating Coils. IMPERIAL CHEMICAL INDUSTRIES LTD., P.O. Box 216, Birmingham, 6. In the plating industry these coils have been very successful. This presents the picture so far and shows what performance to expect. 11 pp., ill.

Welding Rods and Brazing Materials. IMPERIAL CHEMICAL INDUSTRIES LTD., P.O. Box 216, Birmingham, 6. Experience in the products for joining copper, titanium, aluminium and their alloys. 12 pp., unill.

Oxide Refractories. MORGAN REFRACTORIES LTD., Neston, Wirral, Cheshire. Revised version of introduction to high purity oxide refractory bodies. 2 pp., ill.

Lubricants in Glass Making. GRAPHITE PRODUCTS LTD., Northfields, Wandsworth Park, London, SW18. Introduction for those who haven't already met Foliac graphite dispersions. 2 pp., ill.

Fuel Treatments. COMBUSTION CHEMICALS LTD., 33 Dorset Square, London, NW1. Indicates where to use liquid and powder additives. 4 pp., unill.

Marketing

Finland's Future Decision On Western Trade

THE visit of the Finnish Trade Minister, Mr. Ahti Karjalainen, to Moscow for talks on trade preference again brings to the fore the question of a possible form of association between Finland and the European Free Trade Association.

The Finnish economy is not only geographically, but also in its terms of trade, substantially in the shadow of Soviet economic policies. Finnish membership of Efta would be very much a matter for delicate negotiation in Moscow.

The Finnish authorities have made it plain that they are fully aware of the need not to allow their trade relations with Western Europe to drift into conditions of disadvantage to their own forest product and engineering industries.

In Finland the economic climate has been improving. Unemployment this winter is considerably less than for some years past. The Finnish Government will not want these gains to be lost by their close association with Russian trading organisations preventing the expansion of their trade links with the West.

Petrochemical Industry Starting up in Sweden

The petrochemical industry now being founded in Sweden will at first be based on plant which Esso is building at Stenungsund, north of Gothenburg. The Esso plant, a steam cracker, will supply two plants which are to be built locally to produce polythene and ethylene oxide.

The polythene plant will be jointly owned by UNION CARBIDE and FOSFATBOLAGET. The ethylene oxide plant will be owned by another important Swedish chemical concern, MO OCH DOMSJO.

The Esso plant at Stenungsund will be able to use materials from gas oil to natural gas. The nearest of the group's refineries is at Oslo, Norway. It is expected that the steam cracker will come on stream early in 1963. Its input capacity will be between 250,000 and 300,000 tons a year.

The most significant product of the plant will apparently be ethylene with propylene and butadiene also being manufactured.

BMC Truck Production In Spain

The BRITISH MOTOR CORPORATION are to join with a Spanish company in producing commercial vehicles for sale in Spain.

The Spanish company is the SOCIEDAD ANONIMA VEHICULOS AUTOMOVILES (SAVA), fo Valladolid. Permission has been given by the Spanish Minister of Industry and Under-secretary of Commerce for the BMC cooperation with Sava.

The Spanish company at present produce commercial vehicles at Valladolid in the two and three ton class. The agreement is for ten years and the two companies' engineers are now cooperating towards increasing the manufacturing capacity at Valladolid in order to reach the substantially increased production called for by the new agreement.

BMC-SAVA trucks should be on delivery in Spain early next year and there are export possibilities in those countries where Spain has long established trading links.

Agricultural Machinery At Royal Smithfield

British agriculture has the distinction of regularly increasing its output and at the same time reducing its working force by an appreciable percentage every year. Over the last 20 years output per man has increased on the United Kingdom's farms by an average of 90 per cent.

At the Royal Smithfield Show (properly known as the Royal Smithfield and Agricultural Machinery Show) the Machinery that makes this possible will be again on display. The show is this year at Earl's Court, from 5 December to 9 December.

Exports from Britain of agricultural machinery in the first eight months of this year were worth more than £13 million, not counting the tractors. The equivalent figure for 1959 was £11½ million.

Tractor exports in the same months amounted to just over £59 million, against £43 million. Parts and accessories sent overseas increased slightly to £15 million.

It is expected that when figures are available for the whole of 1960 it will be seen that the exports of tractors and farm machinery will have reached the useful total of £130 million. These exports go as far afield as Russia and China in addition to Commonwealth countries, the United States of America and West Germany. This should include, again, more than half of all the world export business in tractors.

The on-the-hoof side of Smithfield is also export conscious. British livestock worth £7 million was exported during 1959.

Ten Point Programme For South Africa Industry

Five year plans are a popular device of governments seeking to accelerate the development, or further industrialisation, of their territories.

It seems likely that a recruit to the five year plan brigade may be South Africa, whose Federated Chamber of Industries has a ten-point programme designed to put more pace into the slow expansion of the Union's economy since the credit squeeze of 1958.

Among the steps the Federated Chamber would like to see are the stimulation of the purchase of Union-made goods (this would include a BUY SOUTH AFRICAN campaign. The reduction of imports and higher tariffs that the FCI would also like to see are closely connected with this aim. Easing hire purchase conditions is another of the points.

Of great general significance for the Union's future are the points covering "improved physical efficiency" which embraces better training for workers and for management, and the added aim of better race relations.

The Federated Chamber's non-European affairs committee has proposed that another approach should be put forward towards the acceptance of African trade unions. The first step that the FCI will apparently try for is that African labour should be allowed to participate in the negotiations of employment conditions.

For the attraction of private capital, which was adversely affected by the Sharpeville shootings and subsequent developments, the Federated Chamber would like tax concessions for new industries, coordination in public and private investment and undertakings in the field of tariff protection.

Canadian Campaign Mobilising for Export

More than 100 of Canada's trade commissioners, drawn from 49 countries, will be meeting in Ottawa from the last day of the month in a meeting which is meant to help Canadian businessmen meet the problems of improving their export performance.

Mr. George H. Hees, the Canadian Minister for Trade and Commerce, has released a statement entitled "Canada Mobilises for Export."

Mr. Hees has drawn attention to the further intensification of the competition in world trade due to "the emergence of trading blocks in Europe and the tremendous step in the trade promotion efforts of our competitors including our Western allies and other members of the Commonwealth."

If legislation is needed to carry out the suggested steps proposed by the trade commissioners to match the Government contributions of competitor countries to their own trading activities, it is believed the Canadian authorities are prepared to consider appropriate action.

The probability is that attention will be very much centred upon export business in secondary manufactured goods.

There is a belief that Canada is particularly well placed to make commercial use of the European market's interest in North American styled goods. There is known to be some criticism in Europe that goods produced in the United States do not always last as long as they might.

The Canadians report an increasing overseas demand for their products as far apart as laminated motor boat hulls and women's clothes.

Mr. Hees suggested that the motto of the Canadian Department of Trade and Commerce might now be "Canada for Quality."

Expanding the Variety Of Marine Radars

The DECCA RADAR Company has further reinforced its claim to provide the widest range of marine radar sets of any company in the world by introducing five new sets, bringing its total to twelve.

Four of the new sets are added to the existing seven in the Decca 3 cm wavelength range. One of the introductions is the first true motion 10 cm marine radar to be produced outside the United States. The company describe this 10 cm set as giving, for the first time, a standard of picture and of display features that is equal to the 3 cm.

By bringing easier interpretation of signals the new range should in the company's view, help to keep down the risk of collision at sea. Decca have fitted more than 10,000 vessels with their radar equipment, over half of all radar-equipped shipping.

Jute Machinery Order For East Pakistan

A £2 million machinery order for four new jute mills to be built in East Pakistan has been placed with British firms, one of them in Belfast.

Delivery of the machinery will begin in the summer of next year. The largest part of the order will be carried out by JAMES MACKIE AND SON, of Belfast, Northern Ireland. The other companies concerned are THOMAS C. KEAY and their subsidiary LAWSIDE ENGINEERING AND FOUNDRY Company, JAMES F. LOW AND Company and GIDDINGS AND LEWIS-FRASER.

Belgian Expansion Outlined by Premier

Another five year plan, this time for Belgium, now without the underpinning of the Belgian Congo, has been described by Mr. Eyskens, the Belgian Premier.

Details of the five year plan followed a budget containing numbers of tax increases. It is explained that by reducing the Government's pressure on the money market fresh funds will be released for industry. The expansion plan continues legislation giving interest rebates, capital guarantees and new plant and building subsidies. These are facilities available to Belgian industrialists as well as to those coming in from abroad. The Government holds strong powers to pick and choose who gets the benefit of these schemes.

An annual production increase of 4 per cent is the official target. It is hoped that 20,000 new jobs will be created each year. For the longer term a 15 year plan is also to be put forward with a reserve of emergency works to be put into operation at the first sign of a recession.

New Desoutter Automation Subsidiary

DESOUTTER BROTHERS (HOLDINGS) have formed a new subsidiary company, CARTER STEVENS (AUTOMATION), which will carry on the businesses of Carter Stevens and Company (Engineering), Carter Stevens and Company (Automation), and Blakeman Designs. All these concerns are located in Coventry.

Desoutter are to subscribe 76 per cent of the issued share capital, in the region of £50,000 in the first instance.

The company emphasises that this is part of their normal programme of development. The new subsidiary's contributions to the group profits during the next few years are expected to be only "very modest."

Reducing the Noise from Diesel Engines

Wider acceptance of high-speed diesel engines for light vehicles would follow a worthwhile reduction in noise. Less noise is likely to be obtained by better combustion. Further reduction can be gained by insulation and isolation.

EVER since the diesel engine came into use in road vehicles it has stood at a considerable disadvantage on the score of radiated noise. Even though much progress has been made in reducing noise at source, and in attenuating airborne or structure-borne vibrations, the concurrent steady improvement of petrol engines has maintained their advantage in this respect. However, further reduction in diesel noise appears possible, and promises a double return.

The fundamental causes of noise in the high speed diesel engine are well known. At conditions of high speed it is virtually impossible to control or even to influence effectively the rate of inflammation by the rate at which fuel is injected into the combustion chamber, as well as to ensure sufficient time for a degree of mixing that will ensure clean and efficient combustion. This means that at the moment when inflammation starts at some point in the combustion chamber, the location of which may be greatly influenced by the particular conditions prevailing, there is a body of partly vapourised fuel droplets whose envelopes of vapour are at, or very nearly at, the SIT (self-ignition temperature) of the fuel. For this reason, the fuel may ignite either from the progressive spread of flame from the initial nucleus or by reason of a body of vapour reaching its effective SIT, or by some combination of these modes. This gives rise, at a chance degree of irregularity, to an intitial rate of change of pressure in the cylinder of an altogether higher order than is the case with the progressive burning of the homogeneous charge in a spark-ignited petrol engine.

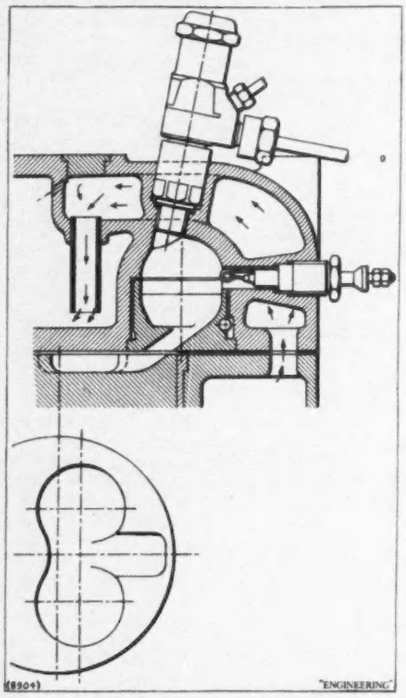
COMBUSTION CHAMBER FORM

The prime importance of the rate of combustion—or rate of energy release—coupled with the cycle-to-cycle regularity of its intensity in the problem of noise control has been stressed by Mr. J. H. Pitchford, of Ricardo and Company Limited, Shoreham-by-Sea, Sussex, in a paper "The Development of the Small Automotive Diesel in Western Europe and Its Likely Role in the USA," presented during the National West Coast Meeting of the Society of Automotive Engineers, at San Francisco. Mr. Pitchford then discussed the various ways in which noise control is being carried out.

A distinctive approach to combustion control is made in one of the most successful pre-chamber engines of today, the Mercedes-Benz. Here it would seem that during the past few years their research engineers have come to realise the importance in this form of combustion chamber of preventing combustion of any part of the injected fuel outside the pre-chamber before inflammation has been initiated inside. To this end, a physical obstruction on the axis of the injector in the pre-chamber is used. The measure has been notably successful in this form of chamber, where the pre-chamber volume is relatively small and the coaxial passage connecting it to the cylinder is also small in relation to the total quantity of injected fuel. The intensity of noise in recent models of this engine has been very greatly reduced and its regularity improved.

Another mode of combustion is that engendered in the type of combustion chamber used in Ricardo engines. This is shown in the diagram. In this form of chamber, the company have sought to combine an extremely high air utilisation (up to 94 per cent has been obtained), and consequently high bmep figures, with a fuel consumption that reflects only slightly the pumping and heat losses consequent upon compression turbulence. The clearance volume is in fact equally divided between swirl chamber and piston cavities, and a relatively larger throat area can be tolerated with the highly organised air movement characteristic of the system. With this system, perhaps one of the most stubborn difficulties has been, throughout, the achievement of a worthwhile reduction of irregular combustion noise at light loads and when idling.

To investigate the processes of combustion, use was made of a Woolensach "Fastex"



While this design of combustion chamber gives high air utilisation and good fuel consumption, irregular combustion noise at light loads is a problem.

camera operating at about 15,000 frames per sec. Some eight years have been spent developing a rig using this camera for high-speed colour photography. By coupling it automatically with photography of the corresponding gas and fuel pressure characteristics and the injector needle movement, a very complete picture of what is happening is being obtained. This has already led to a clearer understanding of the way in which compression ignition combustion develops. In the case of the swirl chamber, combustion tends to start near the inner mouth of the connecting passage and to spread very rapidly into the piston cavity. It is found that if the initial nucleus can be moved more into the centre of the swirl chamber and "located" there more precisely, there is a considerable benefit from the point of view of quieter running.

TRANSMITTED NOISE

Further reduction of noise can be produced by minimising its transmission from the cylinder. Current work in this field tends to show that the direct structural transmission of frequencies in the irritating range can be kept low in the transmission path by the flexible mountings of the engine, and do not call for serious consideration as compared with the airborne transmission of such frequencies. Clearly, the transmission, amplification, and radiation of combustion frequencies as airborne noise involves the whole structure of the engine, and a number of measures can be taken to reduce total noise radiation.

Piston clearances should be maintained at the absolute minimum comparable with normal load requirements. Main bearing diaphragms must be well ribbed and supported against flexing under load, specially the two-end ones. Wherever possible they should not be too dependent for their location and their individual rigidity upon their attachment to the main external crankcase walls. Indeed, if one could imagine an engine without crankcase walls as such, and with the main bearings carried in immensely stiff housings suspended, simply and directly from the cylinder block, one would have a relatively quiet engine.

Wherever possible, unstressed covers, pressed or cast, should be acoustically insulated from the main stressed structure. For example, the valve cover, and in many cases the front end timing cover, need have no direct metallic contact with either of the faces against which they bear or the studs and nuts which secure them. The main surfaces of these covers should be generously ribbed or dimpled, and in the future could reasonably be manufactured in acoustically-unresponsive plastics materials.

DAMPING FUEL PIPES

While the engine structure itself and the exposed ends of the crankshaft—fan pulley/damper and flywheel—are the major noise radiators, there are other sources that should not be ignored. The air intake of the diesel, unless a vacuum governor is used, tends to be notably more difficult to silence than that of a carburettor, the offensive acoustic energy being in a lower frequency range. Fuel injection equipment, too, is far from blameless, particularly in the direct-injection form of engine where high injection pressures prevail. A good deal can, in fact, be done by using wherever possible the flange-mounted types of injection pump which do not call for an external coupling, by damping high pressure fuel pipes by means of clamps and other devices, and by the use of synthetic rubber springs or steel springs moulded in synthetic rubber for the injectors.

Even after the total energy radiated from the engine structure has been reduced, it can be still further attenuated. From the point of view of those inside the vehicle, a very great deal can be done simply by a more widespread and generous application of the various sound absorbent and acoustically damping materials that are today used in normal petrol-engined vehicles. Where it can be arranged, an additional bulkhead between the engine and driver compartments pays off handsomely.

A much more effective approach, but one which is relatively awkward to apply to conventional passenger cars, is the containment of the power unit within a completely enclosed and suitably lined inverted horseshoe section, connecting at the forward end with the fan shroud and discharging through a flattened or suitably shaped orifice at a downward angle beneath the toe board. This measure, if carefully carried out, is extremely effective. While difficult to apply to existing vehicles, it could well be designed into a new project. It is well suited to the forward control vehicle such as the light van.

A relatively large difference in engine noise levels still exists between the modern petrol engine and its diesel counterpart. While it seemed probable to Mr. Pitchford that very great strides would be made during the next few years in abating this difference, both by tackling it at its source in the combustion chamber and by engine insulation and isolation, he did not think it probable that anything like equality would be reached, at any rate in so far as noise external to the vehicle is concerned.

Packing Bags at High Speeds

A new high speed bag packer which will handle calico, jute and open topped multi-wall paper bags in the 50 to 150 lb range is being marketed by Thomas Robinson and Sons of Rochdale. Designed by the company's Australian associates, it is electro-hydraulically operated and is normally installed on two floors of a factory, a weigher being mounted on an upper floor above the packing and sewing section.

Packing speeds obtained on recent tests carried out with flour are eight bags per minute with 70 lb bags and six with 140 lb.

In operation, five manual switches are made controlling the weigher, packing auger, hydraulic pump, transporter and sewing heads, together with the system which feeds the weigher. When the weigher is full and ready to tip, a " weigher full " sign is illuminated on the control panel of the machine.

Bags are placed on the packing tube by the operator who depresses a pedal to start the completely automatic packing cycle. The pedal switch immediately operates the hydraulic clamp for holding the bag and sliding it up and down the tube.

The weight of the bag is taken on a fork lift table mounted on a vertical ram. This table rises to within 1 in of the packing tube, ensuring that material is packed into the bottom corners of all bags. Packing density depends on the rate at which the ram descends. To enable varying degrees of pack to be obtained, a loose and tight pack control valve is fitted.

When the weigher motor is energised, the material to be weighed is fed into a weigh pan until 80 per cent of the full load is delivered. A mechanism then operates and energises two thrusters, thereby closing a valve and reducing the feed to a trickle until weighing is completed. When this happens, an automatic switch applies the brake.

Situated below the weigher and suspended from the weigher frame is the auger packing section. Within the stainless steel packing tube there is a continuous packing auger running in ball bearings and driven through a hydraulic fluid coupling by a 15 h.p. motor. The function of this coupling is to slip when peak load is reached, thus taking the strain off the bags and avoiding bursts. The initial surge of material from the weigher is also cushioned by this coupling.

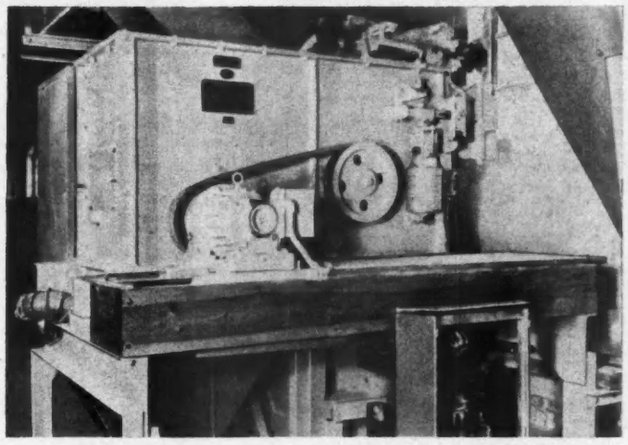
The actual packing or " lying " of the material is accomplished by an impeller with two aerofoil-section blades. This is mounted at the end of the auger so that no unpacked area exists under the auguer spindle end. This ensures a more uniform density and gives a bigger lip for sewing.

The transporter section, under the control of the sewing operator, is supported on three legs and can be raised or lowered to suit various bag sizes by employing a central hydraulic ram operated by a small hand pump. By means of a double action switch, the sewing operator starts the V-rope transporter before the bag reaches transporter level. Further pressure on the switch brings the sewing machine into operation.

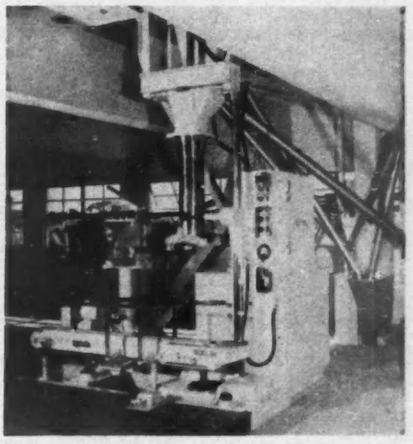
Two sewing machines with 1¼ h.p. motors are mounted on a ball thrust turret with a quick adjustment lever. The machines are arranged back to back on the turret so that broken needles can be replaced from the back of the packer without interfering with the sewing operator, simply by swivelling the turret. A power plug and manual switch are provided to enable the spare machine to be tested without loss of production.

Situated at the rear of the bag clamp shaft are the control cabinets, the lower one housing an hydraulic oil tank of 32 gallons capacity and a hydraulic pump which is directly coupled to a 5 h.p. motor. All electrical gear is enclosed in the upper dustproof cabinet.

Solenoid operated hydraulic pilot valves are used to actuate the main hydraulic valves for the bag clamps and main table ram, thereby eliminating intricate mechanical linkages. Only a small quantity of fluid is used for each movement. This produces an instantaneous and positive operation.



(*Left*) *The weigher unit with a de-aerating conveyor feed above. The drive to the packing auger can be seen below the weigher drive.*



(*Right*) *This high speed packer, which was recently installed, handles the entire 17,250 lb per hr ouput of a Philippine mill in 50 lb bags. Only two men per shift are employed on the machine.*

Protective Coatings for Heavy Equipment

What is reported to be a unique industrial service, the application of a comprehensive range of anti-corrosion and protective coatings to heavy equipment up to 5 tons in weight, under factory conditions, has been established in the Manchester area.

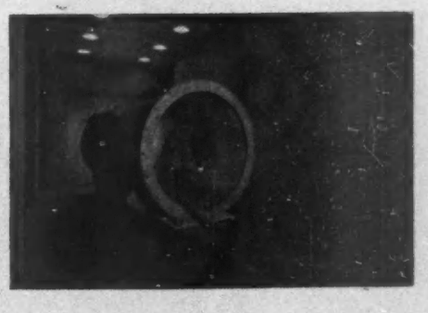
The new service is based on specialised plant recently installed at Norton Street, Miles Platting, Manchester, by West's Loyne Limited, a company formed jointly by WGI Limited (West Group of Industries) of Manchester and Loyne Limited who are specialists in protective coating from Ashton under Lyne.

The establishment of such a service will be welcomed by many industries because of the serious shortage of purpose-built plant designed for the specialised coating of large fabrications. Though some manufacturers operate their own coating plants, the range of coatings applied is limited and there is an increasing demand from producers of many types of equipment for the application of protective coatings to items in the 1 to 5 ton range. It is claimed that this is the first time that such facilities have been made available under conditions where close control can be maintained throughout the process, from initial preparation to final curing.

The plant includes one of the largest fully automatic shot blasting cabinets installed in Britain for this kind of work; there is also a large gas fired oven for sintering and stoving of coatings and the heat treatment of metals. The installation is complete with modern preparation and coating equipment and the necessary cranes for handling large components during treatment in the plant.

Among the coatings which can be applied are the following: epoxy resins for the lining of vessels containing food, oil or chemicals; phenolics which are water and acid resistant; synthetic rubber for abrasion resistance and corrosion prevention; ptfe non-stick dispersion coatings for a variety of uses in industrial and domestic equipment; ptfce for insulation and resistance to high temperatures and corrosive gases and liquids; silicones for their non-stick and heat and chemical resistant properties; metal spraying of zinc, aluminium and stainless steel; and flame spraying of plastics.

Other facilities available at the plant include the shot blasting of large vessels in the open with mineral grit; and, if required, work can be prepared by flame cleaning and power wire brushing. Both powder and wire metal spray guns are used for flame spraying of metals as well as for synthetic coatings.



Inside the new automatic shotblasting cabinet which will take work up to 30 ft by 12 ft by 12 ft.

Automatic Hard Chromium Plating in Use

Hard chrome plating by automatic equipment is a specialised process now being used by a growing number of manufacturers. One of the latest developments is the plating of cylinder liners.

For a number of years, Laystall Engineering Limited have worked on the development of steel cylinder liners for internal combustion engines. They have recently formed a new company, Laystall Cromard Limited of Wolverhampton, to specialise in the further development and mass production of their "Cromard" liners. This company is fully equipped with special purpose machines and includes what are probably the largest fully automatic plants to be installed for hard chrome plating liner bores.

Cromard thin wall liners are produced from deep drawn steel pressings which are machined, ground, bored and lapped to a very high accuracy before reaching the point in production where the hard chrome surface is deposited in the bore. This plating process is carried out in automatic units specially designed for the purpose by W. Canning and Company Limited of Birmingham. These plants are developments of the Trojan return-type design, having a short lifting section and an extended fixed carriage. The lifting section is operated by a low pressure hydraulic system through mechanically operated valves. A rack and pinion interlocking mechanism ensures that the lift cylinders are permenently in phase and there are no flexible hydraulic connections—pressure and return lines being telescopic tubes.

Transfer of jigs from one process tank to another is carried out by hydraulically operated traverse bars. Conveyor chains and counterbalance weights are dispensed with, and the number of electrical limit switches reduced to a minimum thereby reducing possible causes of desynchronisation. All hydraulic gear for the traverse and transfer mechanisms is carried by the steel centre structure, and is operated by a power unit situated in a convenient position remote from the plant. The workarms which carry the jigs are the only parts of the plant which overhang the plating and process tanks, thus reducing the possibility of corrosive attack on the operating structure and eliminating solution contamination from oil drips. Each plant has a rated output of 40 liners per hour with 0·003 in of hard chrome deposited in the bore and operates on a 24 hour, 6 day week basis.

The hard chrome plating sequence is relatively simple—the actual plating section accounts for about 80 per cent of the sequence, the other 20 per cent incorporating etching, neutralising and swills.

Before plating, the liners are first degreased and then attached to the plating jigs. Each workarm carries two jigs incorporating fixed tubular lead anodes. The liner is placed over the anode and clamped accurately in position by the jig. A contact track is fitted to the carriage to provide the anodic current. This is additional to the normal contact track, and both anodic and cathodic currents are carried to the internal anodes and the liners via the jigs and workarms.

The first operation is a chromic etch and for this the polarity of the current passing to the liners is reversed. After etching, which prepares the bore surface for the chrome, the liners are transferred automatically to the hard chrome section. This is long enough to accommodate 60 liners in various stages of plating. During a plating time which is variable from 90 to 150 minutes, the required thickness is built up in the bore as the liners are traversed through the tank.

In order to control the heat produced by the high current densities associated with hard chrome plating on this scale, a heater/cooler has been incorporated in the design of the chrome tank. This system works on a closed circuit principle and is automatically controlled so that the plating solution is quickly brought up to operating temperature after a shut down. Excessive heat is dissipated by an external cooling tower during normal operation, so maintaining the solution at its correct working temperature.

After plating, the work passes through two "drag out" tanks. These work on a counterflow system using gravity flow which passes dilute solution from the second tank back to the first. The first tank is fitted with a transfer system for passing the concentrated drag out back into the plating tank, thus recovering chromic acid and maintaining its concentration.

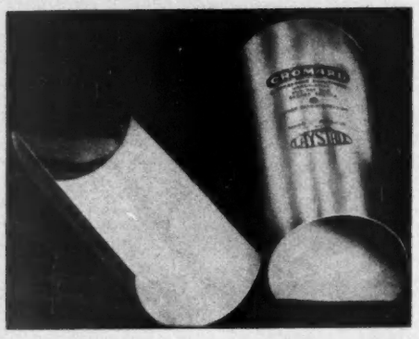
From the drag out tanks, the liners are transferred to an alkaline neutralising tank and then finally to cold and hot water swills.

The etch, chrome and swill tanks are lead lined, and a lip extraction fume removal system is fitted to both etch and plating tanks in order to maintain a healthy atmosphere in the plating shop.

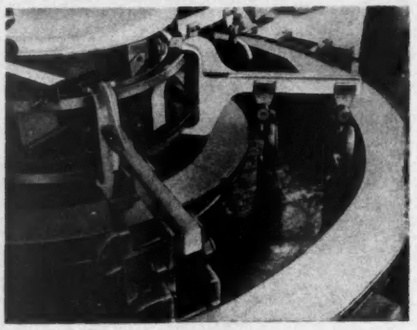
Current consumption for the plating process is in the order of 16,000A, and this is maintained automatically under all loading conditions by constant current density control equipment.

The plant process sequence is under the control of an electronic timer which permits instant variation of the process timing, when required, to increase or decrease the thickness of chrome deposited. This timer is built into the main control panel which also houses push button controls and pilot lights for all ancillary equipment.

Laystall find that this particular automatic plating system has provided the full measure of benefits to be derived from automatic equipment. Plating productivity is increased while operating overheads have been reduced. Plating control is simple and accurate and deposits are of consistent quality and uniformity with a negligible reject factor.

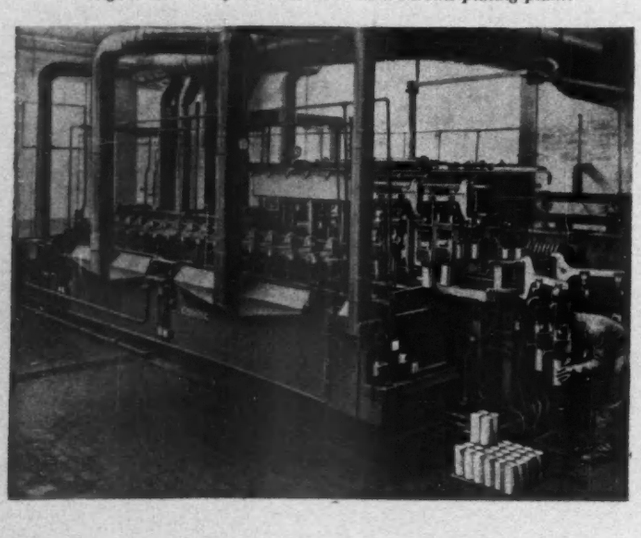


The finished product—Cromard cylinder liners.

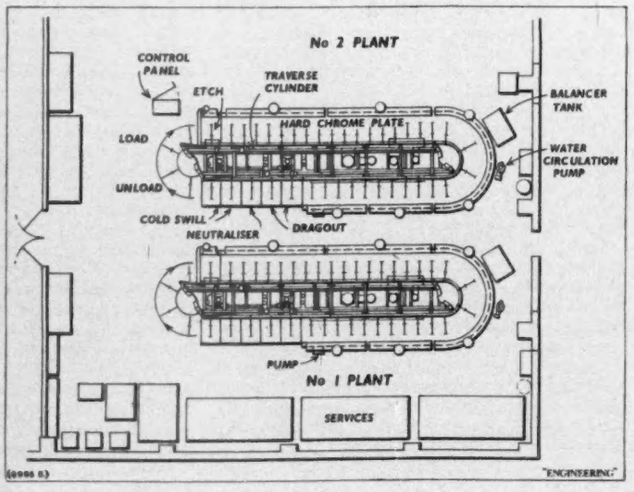


A detailed view of the workarms showing the construction of the plating jigs. At this stage, the liners are passing through the hard chrome plating process.

A general view of the automatic hard chrome plating plant.



The layout of the plating plant showing two units installed.



Hot Dimpling

The advantages of hot dimpling in that it provides crack-free dimples for flush rivets or fastenings are well known, particularly to the aircraft industry. In order to exploit this process as widely as possible, a fully automatic machine has been designed, developed and manufactured by Short Brothers and Harland Limited of Belfast. The necessary precise operation of the dies is achieved by a pneumatic/hydraulic system and the proprietary equipment selected for this purpose was manufactured by Maxam Power Limited, a company within the Holman Group, of Camborne, Cornwall.

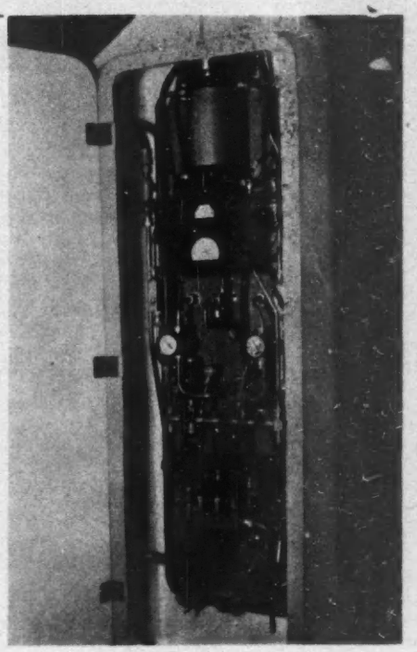
From the initiation of the development programme, two requirements were regarded as essential. Firstly, accurate temperature control was of primary importance, and for this to be effective a fully automatic operating cycle would have to be incorporated, to reduce the possibility of human error to a minimum.

Preliminary trials were carried out with a manually controlled unit and with a portable tool incorporating automatic control. The successful outcome of these tests led to the design and development of the final production machine. This consists basically of robust castings forming a yoke which supports the male and female dies, the latter being mounted directly on the lower jaw. The upper die which is movable is mounted on a hydraulic ram which is operated by an electrically-controlled pneumatic/hydraulic system. All control and setting arrangements are built into the main castings and all components are readily accessible for setting or maintenance.

The dies are electrically heated, temperature being electronically controlled. This electronic control system also controls the Maxam solenoid-operated pneumatic valves which function, in accordance with the temperature control, to exert the forming pressure in two stages.

The control unit prevents initiation of the operating sequence until the dies are at the right temperature. When this temperature is reached, the operator positions the component on the tool by means of a predrilled hole and presses a foot switch which initiates the automatic cycle.

The control circuit is completely interlocked with appropriate relays incorporated, so that, once the cycle of operations is initiated by the operator, control passes entirely to the automatic system and no action by the operator can influence the completion of the process in accordance with the preset sequence. In this way, a consistency of results is ensured which is beyond the influence of human fallibility.



The hydro-pneumatic system of the hot dimpling machine.

Clean Pipework for Nuclear Reactors

Stewarts and Lloyds Limited have recently formed a Pipework Engineering Division to concentrate on the fabrication and manipulation of various types of products from tube. Some of the more interesting work done by this division is on nuclear reactor components.

An important requirement for such components is that they must be scrupulously clean because certain elements in dirt and dust particles could damp down the reaction and could also become radioactive. To achieve the necessary degree of cleanness, Stewarts and Lloyds employ a series of clean conditioning processes and have constructed an impressive clean shop at their Tollcross works.

Individual parts are degreased, shot blasted and vacuum cleaned before entering the clean shop where they are further vacuum cleaned and dipped in a protective liquid to prevent rusting. The parts are then assembled in the clean shop, where the air is filtered to exclude dust particles down to 0·001 mm in size. The completed assemblies are sealed before passing to the ordinary atmosphere outside.

The clean shop is a building within the main shop used for nuclear engineering work. The floor area of the clean shop is about 7,000 sq. ft and is divided into two main compartments—one for vacuum cleaning and dipping in protective coating and the other for final assembly. It is a dust proof construction with double glazed windows and rubber edged doors. The floors have a special surfacing and the rest of the interior is finished with a gloss paint which is free from any constituents which might contaminate the products. Electrically heated and filtered air is supplied to the shop under pressure. Personnel enter through a changing room and wear special white overalls, caps, gloves and rubber boots.

Looking along the assembly compartment of the clean shop.

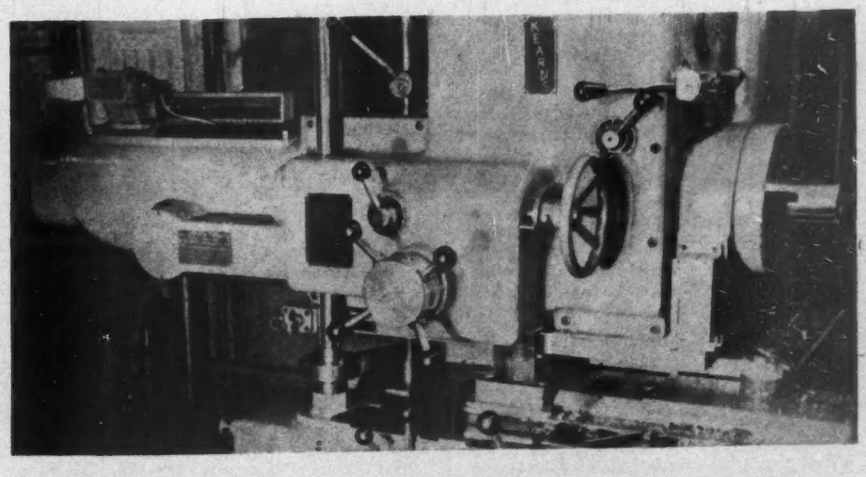
Optical Depth Control

A new aid to coordinate setting in the form of an optical depth control to the travelling spindle is now available for Kearns Series 45 or 72 horizontal boring machines, and No. 2 or 3 Kearns patent horizontal boring machines. This system employs a graduated scale and a projection screen measuring 4 in by 1½.

The fixed scale is mounted on the spindle feed bracket and an optical unit carries the projection screen on which a vernier subdivides the magnified main scale readings into thousandths of an inch or hundredths of a millimetre.

Clamping of the bearing to the travelling spindle enables the spindle to be gripped in the most convenient position for the workpiece to be machined. A further fine adjustment on the scale mounting enables the readings to be set at zero or the nearest whole number. In the majority of cases, the 12 in traverse provided is sufficient, but reclamping of the rear spindle bearing allows full spindle traverse to be used.

Using normal spindle feed rates continuous readings may be taken from the main scale to 0·01 in. Final reading and setting of the spindle is direct to 0·001 in.



A horizontal boring machine fitted with optical depth contro to the travelling spindle.

Launching Black Knight Without Fail

The conspicuous success of the Black Knight programme is the result both of rigorous design and of thorough planning of test and launching operations. Progress from East Cowes to Woomera is closely programmed.

By the end of July this year the number of successful Black Knight launchings stood at eight, with no failures. Altitudes achieved varied from 300 to 500 miles. No other rocket has had such a remarkable record.

Designed and manufactured on a restricted budget, Black Knight has clearly shown that successful results do not depend on limitless resources. From the design point of view, the secret of the reliability and high performance of Black Knight lies in its basic simplicity. But that is not the whole story. The process of launching the rocket from Woomera, which starts when the rocket rolls off the assembly line at East Cowes, is a highly complex operation, full of unexpected developments but working to a strict time schedule. A significant part of the credit for the success of the rocket must be allotted to the skill with which this operational programme was conceived and carried out.

An account of this operation was recently given in a paper " Problems in the Launching of the Black Knight," by C. E. Tharratt, read before the Society of Engineers.

After manufacture at the main works of Saunders-Roe Limited, Black Knight travels by road to High Down, the static testing station close by the Needles at the western tip of the Isle of Wight. Many months before a launching in Australia, a programme of all work to be carried out is drawn up. In general, this will cover the incorporation of modifications to the vehicle and ground installations both at High Down and Woomera, the supply of additional equipment to Woomera by sea and air, the time required for normal preparation plus any additional tests, and all the formalities to be observed in transporting the rocket and personnel half way round the world.

FUNDAMENTAL CHECKS

All this is governed by a particular moon phase in Australia. For, to date, all launches have been carried out within the hours of astro-twilight. So critical is the period that a daily check on progress is maintained, and effort stepped up when difficulties are encountered. With the early rounds, the programme was based on a six-day week with the seventh day in reserve to maintain the programme. As more experience was gained planning was switched to a five day week, with the weekend as a buffer to control the programme. Unfortunately, Parkinson's Law more often than not holds good and, as the date of despatch to Australia or launching draws near, work tempo builds up until round-the-clock conditions exist.

From the time the vehicle enters the preparation building at High Down, a different philosophy of testing is applied to that normally used in a production shop, since the systems of the rocket must now be operated collectively. For example, after the control engineer has checked his system in detail and is satisfied that all circuits are correct, one final check is carried out. This consists of physically moving the vehicle in a given direction and noting the direction of response of the motors. So fundamental is this check that on a range the vehicle is not finally accepted until the most senior engineer present has seen it performed.

At High Down there are two launcher areas for static firing tests. After the completion of preparation, the vehicle is loaded into one of them. Three main tests are then carried out. First, an overall interference test to check that electrical systems with sources of radio frequency power or radiated switching transients do not interfere with each other or destroy the system. Then each system is made fully operative and examined as it goes through a given programme. Finally, an acceptance firing is carried out, during which the control, hydraulic, and air pressurising systems are exercised. The vehicle is then removed and packed for despatch.

END PRODUCTS—RECORDS

One of the many problems in rocket engineering is that of maintaining a programme. This is particularly true during a period of an important test, such as an acceptance test, which will probably take four days to complete—two days for setting up the various systems, one day for a full-scale rehearsal (called a System and Sequence check) and one day for the actual test. Black Knight has a multitudinous variety of circuits, each interlocked with the others; so that if one fails, the testing sequence is stopped until the fault is cleared. If a given system is not cleared at a given time then the sequence time is held until the fault is cleared, after which the sequence time is allowed to run on to time Zero or to the next fault. As time Zero approaches, the rate at which the various services and systems are switched on becomes so complex that the final two minutes are carried out by automatic equipment, initiated by the Sequence Officer, who monitors the sequence time throughout the test.

Reliability of components is essential for the correct functioning of a rocket vehicle. Many of the components, however, may be of new or modified design. Under normal circumstances each would have been subjected to exacting environmental and reliability tests. But this is not always possible, and the real test is how the component behaves when mounted in the vehicle. It is therefore necessary to keep an accurate log of all the important items within the Black Knight, so that an accumulation of experience can be acquired. To do this, a method of logging has been devised such that each system has its own log, thus enabling as many engineers as possible to put down information on their own particular equipments. The result is a comprehensive log of ten volumes packed with vital information. This together with the records of the launching and flight represents the end product of all the concentration of effort in manufacturing, preparing, and launching Black Knight.

Experience gained on the Black Knight project shows that the transducer must be located at the actual tapping point and be devoid of connecting capillaries. The sensing element should be frequency sensitive, thus allowing a frequency modulated transmission between transducer and recorder. There is little doubt that as rocket engineering expands, more emphasis will be placed on the need for integrated instrumentation systems.

SENDING IT UP DOWN UNDER

It is not until an engineer has worked in the Australian desert that he fully appreciates the value of good lines of supply and communication. At a late stage an unexpected requirement may appear—for an AGS coupling, a gyroscope, a reel of fine wire, a tube of special Bostik, or an explanation of a technical problem. And these must be sent over 12,000 miles, while in the intervening period comes the waiting with an anxious eye on the weather and the calendar, as the days toward the end of the moon phase tick by.

Woomera is a township about 300 miles from Adelaide. The range itself is 30 miles further on, and messing arrangements for it are based at the outstation of Koolymilka, some 4 miles from the launching area. At the range head are similar facilities to those at High Down with the addition of extensive instrumentation facilities, guidance equipment, and down-range tracking posts. The pattern of work is now concentrated on matching the various systems to the ground equipment. During this period the break-up circuits are tested for radio frequency pick-up from range interference, and a static firing is carried out to prove that all systems, and the propulsion system in particular, are within specification. With these tests satisfactorily completed, and weather permitting, the launching takes place within two days.

SAFETY PRECAUTIONS

The safety of personnel, and thus the safety of the vehicle, is the concern of the launcher officer, and the in-flight safety officer. The former is responsible for all safety matters while the vehicle is on the ground. Throughout the burning phase, the in-flight safety officer has to decide whether to blow up the vehicle or let it carry on. Throughout the flight, a line is traced on a plotting table showing the predicted point of impact if at that instant the motors, by accident or design, should shut down and the vehicle consequently follow a ballistic path. If the predicted impact trace crosses the safety boundary between the range and the homestead areas population: (1 man and 5 sheep per sq. mile), the command destruction system must be operated, shutting down the propulsion system and initiating the break-up charges that will rupture the vehicle tanks.

Launching time will be about 19.00 hours, the sky will then be black and the long range weather forecast will have predicted a wind speed of less than 30 knots. As preparation of systems and fuelling take place, the range equipment and facilities, such as the radar and telemetry stations, the optical trackers, the contraves, the acoustic impact predictors for the head, and the Wilde photo-theodolites for accurate trajectory plotting are brought up to standard. Recovery men with land rovers, helicopters, and light planes take up their positions near the impact area and nearby sheep farmers are warned of the impending launch. Koolymilka is evacuated.

At " minus two minutes " the automatic firing sequence starts. A few seconds after time Zero the vehicle slowly leaves the launcher, four exhaust flames effectively increasing the length by 50 per cent. The thrust developed is over 16,000 lb and the rocket is being steered with an accuracy of better than a quarter of a degree. At all-burnt the velocity is approaching 11,000 ft per sec and shortly afterwards the head is gently separated and positioned for re-entry. As it penetrates the earth's atmosphere again it telemeters the vital re-entry information that the experiment is designed to give.

At a predetermined height, a set of explosive bolts is initiated and a drogue ejected which effectively reduces the head's speed to a safe level before impact. During this period, the recovery party have already taken bearings on the ionised trial and are making plans for an early start on the following morning to recover the head and any remains of the body. Each member travels along his compass bearing to meet up with the rest of the group at the impact area. Then helicopter and ground vehicle searching is carried out until the remains are found. Accurate impact bearings could only be given after careful analysis of the trajectory data, and this could take several days. The successful results of the recovery party in locating and retrieving the remains has proved the value of a land range compared with a sea range, where recovery is much more difficult.

The problem of piecing together the evidence and forming an accurate picture of what really happened during the flight then begins. All this must be gleaned from a few pieces of twisted metal, a re-entry head, and a pile of records.

Diesel Starting in a Cold Climate

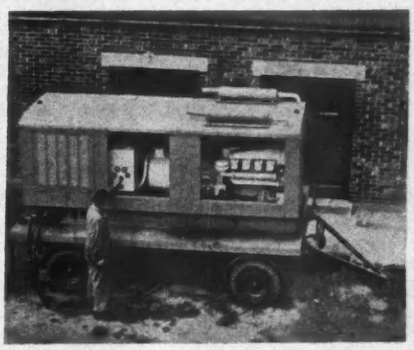
Recent tests by Petters Limited, members of the Hawker Siddeley Group, have shown that their standard air-cooled diesel engines can be adapted for cold starting at temperatures down to − 40° C. To achieve this, only the addition of "Start Pilot" equipment and a sump oil heater is required. Fully automatic operation can be achieved, so that a full output from a standby diesel-generator set can be obtained very quickly in the event of a mains failure, even though the engine may be at arctic temperatures.

Basically, the Start Pilot system produced by Start Pilot Limited uses a patented fluid which is sprayed into the engine air intake manifold in a finely atomised form during cranking. The fluid is a blend of constituents having self-ignition points which form a progressive series, starting from a very low temperature. Thus it ignites readily under compression in the cylinders and ensures combustion of the regular fuel. Normally the fluid is atomised and sprayed into the engine by means of compressed air from a hand-operated air pump integral with the reservoir for the fluid. For automatic starting, however, on unattended engines, an automatically operated source of compressed air has to be provided.

Tests using hand-operated cold starting equipment were recently made on an aircraft hydraulic test rig to which a Petter PDV8 engine was fitted. The engine is rated at 88 b.h.p. at 1,500 r.p.m. and the rig checks all the hydraulic systems on an aircraft during ground servicing. The tests, made to confirm that the engine complied with Admiralty requirements, was carried out in the stratosphere chamber at Vickers-Armstrong Limited, Weybridge, Surrey. A Sea Vixen aircraft was located in the inner part of the cold chamber, with the Petter driven hydraulic rig in the outer part. The actual temperature of the rig was about 4° C higher than that of the aircraft. The exhaust system of the engine discharged outside the chamber.

The cold starting requirement laid down by the Admiralty was for a temperature of − 36° C. For this temperature AVTUR fuel (Shell Aviation Turbine Fuel) and an SAE 5 lubricating oil were used. It was decided that a Start Pilot model ER pump should be fitted.

Tests started at a temperature of − 12° C. A good start was obtained in 10 seconds and, with two further injections of fluid, steady running at full speed was obtained in 25 seconds. Further tests were arranged at decreasing temperatures, until the required temperature of − 36° C was reached. Deposits of ice and frost could be seen on the inlet manifolds, air cleaners, and cowlings, but a good start was achieved,the engine running up to full speed in less than a minute with an oil pressure of 40 lb per sq. in. On various occasions during the tests the temperature was lowered to − 40° C and starting was still achieved. On completion of the cold chamber tests the rig was left in the open to regain its normal ambient temperature, and during the early stages of the thawing out process became coated with a layer or ice over 1 in thick. When this had disappeared, the engine again started easily.



The automatic stand-by generator for one of the main radar heads at London Airport will accept load 7 seconds after mains failure, at temperatures of − 15° C.

Tests were also carried out with automatic starting equipment. In this case, a 40 kVA generator set powered by a Petter PDV6 engine had been built to a government specification that required the set to be fully operative within 10 seconds of a starting signal application at − 15° C. The engine was rated at 66 b.h.p. at 1,500 r.p.m. and AVTUR fuel and an SAE 10 lubricating oil were used.

A small battery operated compressor was wired in parallel with the starter motor so as to become energised at the same time as the starter circuit. The Start Pilot model ER initially used was provided with a tapping to admit air from the compressor, and the hand pump was omitted from the assembly. Using this arrangement, on receipt of a signal engine cranking accompanied by spraying of Start Pilot fluid was automatically initiated.

Preliminary tests at −15° C showed that the engine would fire at about 1·5 seconds after signal and accept load after 8 seconds. To do away with any possibility of fall-off in engine speed under load, a variable delay system was introduced, enabling the operation of the compressor to carry on for a predetermined period after the signal, independent of the starter circuit. On the final test at − 15° C, the engine fired at 1 second, and ran smoothly up to speed, accepting the load at 7 seconds. The fluid injection ceased at 45 seconds after the signal, no change in engine speed or noise being discernible. The Start Pilot equipment finally adopted for these sets incorporated an enlarged reservoir holding 400 c.c. of fluid, this amount being enough for four starts.

Cost of Heating Office Blocks by Heat Pump

Possessing office blocks and having to heat them, the Central Electricity Generating Board set out to find out what really was the most economic way to do it. In particular, the heat pump offered such a marked fuel economy that it was considered well worth investigating in detail. To do this, a subcommittee was set up to examine the operating conditions and costs of heat pumps installed in CEGB power stations, and to compare the results with the costs of other heating methods. After undertaking a three year study, the subcommittee has published its findings.

As far as overall costs are concerned, they found that off-peak electric floor warming had the advantage when all costs were taken into consideration. But on running costs alone the heat pump could be 40 per cent cheaper than any other heating method. Thus heat pumps would be in a more competitive position if capital costs and maintenance costs were reduced, and this seems likely, as the models investigated by the CEGB were only in the experimental stage of development.

Two heat pump installations were studied, both using equipment manufactured by J. and E. Hall Limited. At Stourport power station (river cooled) the low grade heat source was water from an outfall culvert to the river, at about 59° F. The plant was rated by the manufacturers at a maximum output of 95 kW at a source temperature of 38° F. At Meaford A, the cooling towers provided a low grade heat source with a temperature of about 73° F, and the installation was rated by the manufacturers at 132 kW for a source temperature of 80° F. Both installations were of the water-to-water type and consisted of a reciprocating compressor (driven by an electric motor), an evaporator and condenser (both of the shell and tube type), and an expansion valve. Initially both operated on methyl chloride, but a change to Arcton-6 (Freon-12) was made at Meaford after the first year of operation. A thermostat situated in a thermal storage tank interposed between the condenser and the building heat distribution network controlling the system, in each case.

It was established that overall seasonal performance energy ratios of between 5 and 6 may be obtained for heat pumps at generating stations using cooling towers where a representative output temperature of 130° F may be obtained. The corresponding value of the ratio for river-cooled stations approaches 3. Energy used by auxiliaries such as source-water and condenser cooling-water pumps reduced the values of the PER for the heat pumps alone by about 10 per cent.

The performance of the heat pumps was compared with the performance of other methods of heating used in the CEGB's administrative buildings. The figures were adjusted so that an indication was obtained of the comparative overall operating costs of heating systems when installed in a generating station administrative building such as Meaford A—176,460 cu. ft, 448,000 Btu per hour per deg. F heat loss. The results, when the fuel and electricity charges are assumed to be those applicable to average commercial consumers, are shown in the table. Off-peak use of the heat pumps would improve their position in the table.

TABLE I:—*Comparative Heating Costs of Different Systems.*

Operation	Heating System	Overall Operating Costs	Relative Annual Cost
Continuous	Bled steam (inset wall convectors)	£1,524	1·0
Off-peak	Directly-embedded floor warming	£1,540	1·01
Continuous	Oil-fired boiler (ceiling embedded panels—1 phw)	£1,585	1·04
Continuous	Heat pump cooling tower source (ceiling coils)	£1,610	1·06
Off-peak	Ducted floor warming	£1,793	1·18
Continuous	Auto-fired coal boiler (free-standing radiators, 1 phw)	£1,956	1·28
Continuous	Heat pump river source (ceiling coils)	£2,179	1·43
Off-peak	Electrode boiler with thermal storage (ceiling and floor embedded panels)	£2,862	1·88

Fuel Unit Costs

Electricity	£7 per kW of maximum demand plus 1·2*d* per kWh consumed for normal continuous operation, 0·85*d* per kWh for off-peak usage
Oil	13*d* per gallon
Coal	£7·5 per ton
Steam	£20 per therm of maximum demand plus 6·4*d* per therm consumed

Plastic Dot Braille Cuts Book Thickness by Half

Britain leads the field in welfare for the blind, and with a new process developed for printing braille by the Royal National Institute for the Blind looks as though it will continue to do so.

The braille alphabet consists of 6 permutations of 6 dots within the shape of two by three. Until now it has been embossed on thick manilla paper by distorting the fibres of the material to form raised dots. The new method maintains the same pattern, but the paper used is about half the thickness—thus reducing the thickness of braille volumes by a half—and the dots, which are uncrushable, are actually a solid dot of plastic ink.

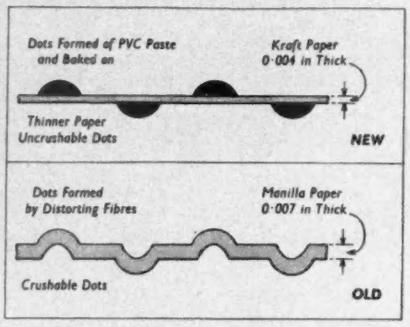
Chambon (Park Royal) Limited, of 8 Chase Road, London, NW10, have designed and built a machine in conjunction with the RNIB for carrying out the process. Kraft paper 0·0035 in to 0·0045 in thick is continuously processed from 3 ft diameter reels holding enough paper for about 3,500 16-page sheets at a maximum speed of 110 ft per min. A specially formulated pvc paste is deposited on to the paper, being applied under a pressure of 40 lb per sq. in to both sides of the paper through a set of 16 perforated stencils fitted to two contra-rotating drums between which the paper passes.

Zinc sheeting 0·010 in thick is used for the stencils. The perforations are done on a transcribing machine, a paper copy being made simultaneously to facilitate proof reading. Correction of any errors is carried out on a machine which obliterates by spinning closed any unwanted holes and piercing new ones.

After the paste has been applied to the paper, it passes to a gelling chamber where it is heated to about 200° C. Difficulties were experienced here on early trials as the gelling temperature of the paste was the same as the flash point of the paper. This trouble has been overcome as also has the problem of finding a suitable material for the bias rollers which, situated within the heating chamber, keep the paper stretched on the stepped rollers.

The paper and the hardened paste dots are subsequently cooled and neutralised by cold air jets fitted with electrostatic eliminators as was found that, after printing, the paper developed static electricity which prevented delivery of neatly folded sheets by the fan folding units.

Plastic dots printed on thinner paper will reduce the thickness of braille volumes by a half.



Flexible Seal Provides Easily Operated Door

As the carriage rolls back, the door peels open.

A door that overcomes the sliding friction inherent in sliding doors in skips or bunkers has been designed at the Central Engineering Establishment of the National Coal Board. It could replace vertical guillotine type doors or horizontal sliding doors. The low power required for its operation, and its freedom from problems of jamming and freezing make it suitable for automatic control.

It consists of a flexible seal held across a discharge opening by a series of support rollers mounted in a movable carriage frame which can withdraw or replace the seal. One end of the seal is attached to the top edge of the opening and the other, after being inserted between the opening and the support rollers, is lapped around the first support roller and fixed to the movable carriage. The carriage consists of two side plates, joined by tie bolts which form spindles for the rollers to rotate on. As the carriage is drawn back, the support rollers withdraw the seal and it peels away from the opening, hanging down in a loop, as shown in the illustration. When the carriage is advanced, the support rollers progressively replace the seal across the opening.

Since the rollers rotate during the withdrawal action, the seal peels away from the opening and sliding friction between the door and the stored material is eliminated. Such a door is very suitable for bunkers containing fine granular material or of an adhesive nature.

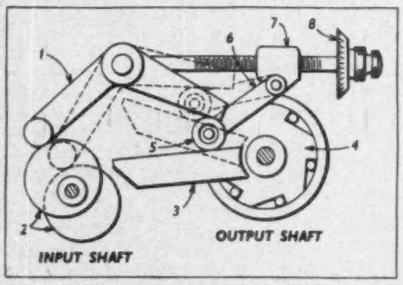
Variable-Speed Reduction Unit Gives Constant Torque

Recently introduced is the Contorq variable speed reduction unit, which embodies a purely mechanical system with a complete absence of fluid or friction properties. The principle is that of a driving lever, pawl and ratchet wheel. In this case (referring to the diagram) there are two primary levers (1) to give continuity of torque, oscillated by means of two cams (2) on the input shaft with their lobes 180° opposed and giving an overlap of approximately 50°. The primary levers, which are bent to suit the configuration of the unit, have roller followers and are spring loaded to keep the followers in contact with the cams.

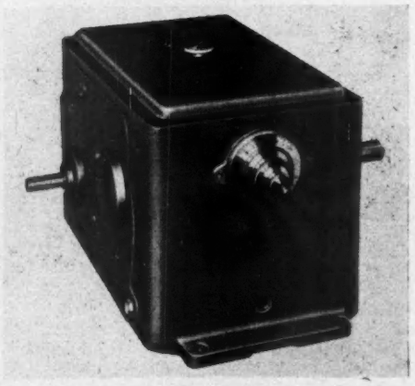
A pair of secondary levers (3), coupled to free-wheel mechanisms (4) on the output shaft, receive an oscillating motion from the primary levers through rollers (5). Clearly, the proportional degree of angular movement transmitted from the input shaft to the output shaft depends upon the disposition of the rollers (5), and so that the speed ratio may be varied, the swinging links (6) which carry the rollers are anchored to a moveable bracket support (7). Variation in position of the support is made by means of the knurled handwheel and travelling screw. A graduated dial (8) outside the case and fixed to the screw indicates the selected speed. With an input shaft speed of 450 r.p.m. the output shaft can be run from 0 to 50 r.p.m. as required, and the ratio may be varied while running or stationary. The cams are profiled to give constant angular movement at the output shaft.

The first production size, the No. 25 unit, has a constant torque output of 2,520 lb-in over the speed range, and other sizes are being developed. As the illustration shows, the unit is enclosed in a case—26½ in long—which incorporates an oil bath at the bottom and ball or roller bearings for all rotating parts. Variation in mounting and relative shaft positions can be accommodated to suit individual applications.

The Contorq has been developed by Fairbairn Lawson Combe Barbour Limited, Wellington Engineering Works, Leeds 1, and is intended for a wide range of power transmission, including textile machinery and conveyor systems.



(*Above*) *Diagrammatic arrangement of the Contorq unit.*



(*Right*) *The unit gives constant torque output and is maintained over the complete speed range.*

Shop Blind Operates With the Sun

Every year thousands of pounds are lost due to sunlight spoiling goods which are displayed in shop windows.

Equipment is now available which will automatically operate shop blinds so that when the sun light reaches the point at which goods will spoil the blinds will come out. When the level of sunlight intensity has fallen, the blinds automatically reverse their operation and travel in again.

A photoelectric cell and transistorised control unit is made by Photoelectronics (MOM) Limited, Oldfields Trading Estate, Sutton, Surrey, and this together with the electric blind—made by Electromatic Shopblinds Limited, 201 Eade Road, London, N4—form the equipment. The combination of design in these two products has produced a reliable unit which is suitable for large and small shop fronts.

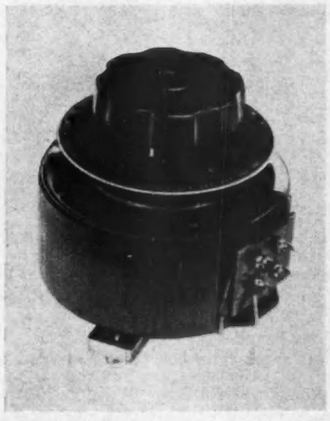
The control unit has two independent settings, one to send the blind out and the other for the return. These two settings enable a varying differential to be obtained according to site conditions and requirements, and can be set to prevent the blind shooting in and out every time the sun disappears behind a small cloud. The same unit can also operate the shop lights, switching them on when the blind is out and off when it is in.

In addition to shop blinds the unit can be made to operate venetian blinds.

Toroidally-Wound Variable Transformer

A toroidally-wound ½ A, 120 W variable transformer has been developed by Philips Electrical Limited at their Eindhoven works. It is claimed to be the first of its kind in the field of variable transformers.

Known as type B8.709.59, it is designed for use on 220 or 240 V 50 c/s, a.c. supply and will



Claimed to be the first of its kind.

provide output voltage continuously variable from zero up to 250 V at a nominal current of 500 mA. It is available as a manually operated unit for panel mounting or in motor driven form.

The sole distributors in the UK are Research and Control Instruments Limited, Instrument House, 207 Kings Cross Road, London, WC1.

Portable Filter For Insulating Oils

Problems of taking large filtration plants to inaccessible places are overcome with a portable oil filter made by Stream-Line Filters Limited, Henley Park, Guildford, Surrey. It enables insulating oil in switchgear, tap changers and the like to be upgraded in a single passage.

The filter—known as the P8—has its own pumping set. It is of robust construction and employs Stream-Line Filter's edge filtration method of removing contaminants from dirty oil, at rates of 50 and 100 g.p.h. when dealing with oil at ambient temperatures of 55° to 60° F. It is claimed that the dielectric strength of the filtered oil will satsify British Standards for new oil.

Two main features of this filter are: its portability—one man can carry it—and, being unheated, it can be operated where an electrical supply for heaters is not available. The only electrical current required is one for the electric motor—approximately 200 watts. Provided any free water is decanted before filtration, the filter can deal with the remaining traces of moisture up to a maximum quantity of about ¾ pint. Solid particles which accumulate can be removed in the normal manner by reversal with compressed air.

If a CN type filter is used, the filter-packs may be dried without removal. The P8 is connected by flexible hoses to the CN plant, and the filter-packs in the former are dried by circulating through both. During this process, the P8 takes the place of the transformer being serviced. By heating under vacuum and ejecting to atmosphere, the water and dissolved gases within the oil are removed.

British Standard for Tubular Heat Exchangers

A much needed British Standard has been issued on tubular heat exchangers. The standard covers cylindrical shell and plain tube exchangers for general applications within nominal shell diameters of 6 in to 42 in, tube lengths of 6 ft to 16 ft, and tube diameters of ½ in to 1½ in.

Information from the Tubular Heat Exchanger Manufacturers' Association (TEMA) and the American Society of Mechanical Engineers has been used in the preparation of the standard and the recommendations of BS2041 "Tubular Heat Exchangers for Use in the Petroleum Industry" has been taken into account wherever possible.

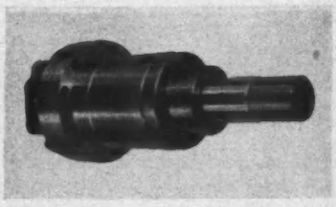
Full title of the standard is BS3274: 1960, "Tubular Heat Exchangers for General Purposes."

Automatic Oscillator Hydraulically Controlled

Regular oscillating of any piece of equipment can be carried out by a hydraulic device developed by Hydraulic Machinery Drives Limited, 101 London Road, Reading, Berks. It gives a controlled stroke and regular frequency.

The oscillator consists of a double acting cylinder with a stroke of ½ in up to 2 in, in increments of ¼ in. A built-in pilot operated directional-valve supplies pressurised oil alternatively to each side of the piston. This gives the reciprocating action. The speed of the stroke can be varied from 6 to 60 strokes per minute.

By incorporating a small control valve it is possible to make the speed of reciprocation independent of load changes. The maximum force available in either direction is 1 ton.



Controlled stroke and regular frequency.

The cylinder bore is accurately honed and the piston rod precision ground before hard chroming and polishing. The unit has flange mountings. Operating fluid recommended is a high grade hydraulic oil having a viscosity of 90 to 120 sec Redwood at 45° C.

Maximum working pressure for the hydraulic oil is 1,000 lb per sq. in, with a maximum flow requirement of 1¼ g.p.m. for a stroke of 2 in at 60 strokes per min.

Typical applications for this oscillator are the operation of the "doctor" blade on photogravure printing machines and on paper making machines.

Push-In Ball Castor

Specially designed for transfer, packing and handling tables, a 1 in ball castor has been added to the existing range of castors manufactured by the Alwayse Castor Company Limited, 79 Longmore Street, Birmingham 12.

Secured without screws, rivets or welding.

Simple fitting is possible since the castor only requires inserting in a close fitting hole and needs no screws, rivets or welding to secure it.

The ball unit can be readily dismantled for cleaning. It will be available in standard, medium and de luxe qualities to suit all conditions of use.

Ship has V-Belt Drive

Ninety-six V-belts are used to transmit power to the propeller shaft of a Norwegian ice breaker and salvage vessel which completed its trials earlier this year.

Each of the four engines develop a maximum of 1,100 b.h.p. and the vessel can be driven by a single engine or any combination of engines up to four. The belts—24 of which are attached to each engine—must withstand a considerable amount of reverse bending caused by jockey pulleys riding on their outer surface.

A common reduction gear for a large output is very exacting on alignment and considerable skill is needed to detect detrimental misalignment in time. Frequently the result is breakdown of the reduction gear causing severe out-of-service delay. By using V-belts, a certain allowance is gained if any misalignment of the pulleys is present.

V-belts—as well as reduction gears—allow utilisation of relatively lightweight high-speed engines in addition to giving more freedom for the disposition of the engines. Thus, in the ice-breaker, space for a further 100 tons of bunker oil was gained in the engine room.

By using V-belts—which are Goodyear E-420 type—engine vibration has been reduced substantially and when high output is required from a vessel of limited weight and dimensions this could be considerable.

The Herkules, as the vessel is called, has a variable pitch propeller which obviates the need to reverse the engines and V-belt drives.

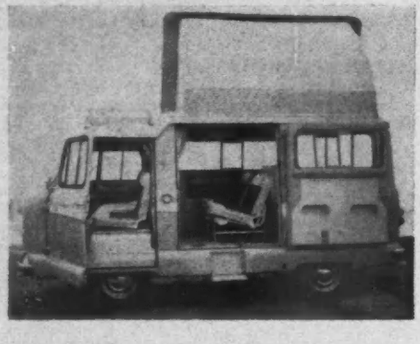
Work and Play on Wheels

MOTORISED CARAVANS were on display at the recent Motor Show, but this year trailer models were excluded. The enthusiast will have to wait till the International Caravan Exhibition, to be held at Olympia, London, from 30 November to 6 December next, to see the latest developments in trailers and in equipment.

Last August the new Caravan Sites Act came into force with the two objects of controlling the location of caravan sites and the improvement of conditions on them. Sanitary arrangements have occasionally been deplorable and sometimes there has been serious overcrowding. Under the new Act, sites exempted from licence are few; apart from those used or run by recognised bodies, or where the caravan is attached to a private house, exemption can only be hoped for if the site is not used for more than 28 days a year.

A large number of the motorised caravans now available are in fact conversions of standard commercial vehicles. As such they are exempt from purchase tax. Since, however, the roof height is too low for anyone to stand upright in them, much ingenuity has been expended in making the roof lift up. No two are quite alike. In the Airborne conversion of the Thames 15 cwt van the centre portion lifts to form a glazed coach-house type cover. The Carefree conversion, available on Bedford, Atlas and Thames chassis, has the whole roof lifting horizontally, while the Dormobile (illustrated) has the roof hinged at one side. Two models that have fixed roofs with enough headroom are the coach built Hadrian (on Austin, Bedford and Commer chassis) and the Highwayman (on Austin 152 chassis only).

The Dormobi e has a roof that swings up.



Inside, the Dormobile will sleep four adults.

A Liteline mobile soundproof office.

Full darkroom facilities are in the Pilgrim.

The Dormobile range by Martin Walter Limited of Folkestone, previously available on Austin, Bedford, Thames and Morris chassis, has added a Commer 15 cwt conversion this year. It is made as either a two or four berth model. The second illustration shows the interior. The rear seats fold down to give two single beds measuring 73 in long by 23 in wide and the two additional beds are obtained by folding stretcher type structures fixed to the body sides at roof level. In addition, a berth for a child can be fitted in the front compartment of the vehicle. Standard fittings include a two-burner gas cooker with grill and space below it for two Calor gas cylinders; plastic wash basin with outside drainage; two plastic water storage tanks; and electric lighting.

New Dormobile models introduced at this Motor Show are those in the Romany series. These have a streamline roof extension with a built-in luggage rack. The roof area has been enlarged allowing wider top bunks than before, and large windows are being fitted in the glass fibre roof panel. Provision is also made for a built-in gas refrigerator and a chemical toilet.

Caravans are used for homes as well as for pleasure (it is estimated that three million Americans live on wheels) and also serve a very useful purpose for business. The mobile showroom has found a big place in the present economy and now a mobile office has been introduced by Coventry Steel Caravans Limited of Newport Pagnell. The trailer touring model is illustrated. Built mainly in aluminium, the Liteline range includes models mounted on skids alone and on skids with miniature wheels for use inside factories where there is a great deal of noise. Thermal and sound insulation are obtained by using Fibreglass and air cavities.

The fourth illustration shows a mobile dark room adapted for tropical conditions. It is one of a series made by Pilgrim Mobile Units Limited, Ringwood, Hampshire. The chassis is steel, giving a body 12 ft long by 7 ft 6 in wide overall with 6 ft 8 in headroom. Construction of the body is aluminium over a wooden frame. The interior is panelled in hardboard with Rocksil insulation. The interior is wired for electricity and fitted with work benches and sinks. Provision is made for connection to an external water supply if one is available. An alternative version is the Pic-aBac which is a complete darkroom designed to fit on a long wheelbase Land Rover from which it can be removed when desired.

ENGINEERING

Published every Friday by Engineering Ltd. at 36 Bedford Street, London, WC2, England.
Telephone: Temple Bar 3663.
Telegrams: Engineering Lesquare London.

Chairman
J. A. Dixon, M.A., A.M.I.Mech.E.

Editor
F. B. Roberts, M.B.E., M.I.Mech.E.

Deputy Editors
D. Fisher, Ph.D., B.Sc., A.M.I.C.E., A.M.I.Mech.E.,
E. P. Ward, M.A., A.M.I.Mech.E.

Department Editors
Atomic Review
D. d'A. R. Blackwall, B.Sc.
Book Reviews
E. P. Ward (Deputy Editor)
Construction
D. Fisher (Deputy Editor)
Design
J. T. Godfrey
Events in Advance
J. E. Dodsworth
Impact, Human Element, Companies, Marketing
J. D. F. Perry
Metals and Materials
D. C. E. Gribble, B.Sc.
New Plant and Equipment; At Home
A. A. H. Scott, B.Sc., A.M.I.Mech.E.
Product Profile
K. M. Brown
Production
J. R. Trotter, B.A.
Research and Development
R. A. Coffee, D.I.C., A.M.Brit.I.R.E.

EDITORIAL DESIGNER
G. T. Page, M.A.

SUBSCRIPTION MANAGER
G. A. Roberts

ADVERTISEMENT MANAGER
G. H. Dixon, M.A.

Contributed Articles
Notes for the guidance of contributors are available from the Editor. Contributed articles usually carry the author's name when published; they should be exclusive to ENGINEERING. When an article is accepted for publication the author is normally advised of the planned publication date.

Subscription Rates
One year, inland and abroad £5 10*s* (Canada, £5 5*s*). Three months 27*s* 6*d* all countries. Single copies 2*s* 7*d* post paid.

Back Numbers
Back numbers, from recent issues to certain of the earliest issues from 1866, are available at the usual price for single copies.

Reprints
Reprints of articles which have been published in ENGINEERING can be supplied. Requests for quotations, stating the quantity required, should be addressed to the Reprints Department.

Engineering Information Service
Assistance is available from Engineering Information Service in obtaining information, and in locating sources of information, both technical and commercial. EIS deals, for example, with names of makers and suppliers of plant and equipment, technical data on design, markets for engineering products, and the compilation of references to information on specific topics. Inquiries should be addressed to Engineering Information Service, 36 Bedford Street, London, WC2.

Advertisement Rates
The rates for advertising in the classified advertisement sections (Appointments, Company Meetings, Trade and Technical) are given in those sections. The Rate Card, covering all advertisements including display, is available from the Advertisement Manager.

The Roselend Dam will control the waters flowing into the Roselend valley from the Beaufort massif. Other streams will also be diverted into the catchment area by means of some 60 km of collector tunnels (with diameters of between five and nine metres). A second dam at Chapelle de St. Guerin will control the waters of the Poncellamont Gorge. Illustrated above is an artist's impression of the Roselend Dam.

FRANCE PUTS THE SAVOY ALPS TO WORK

Atlas Copco and Sandvik Coromant equipment used extensively at Roselend

TO THE TOURIST, the Savoy Alps may conjure up visions of winter sports or long, lazy summer holidays, but to Electricité de France the region means power! The French State power board is building a series of storage reservoirs in the upper Isere area of the Alps, not far from the Italian border. The most important part of the scheme is the Roselend Valley section which will increase France's power reserve by 1,000 million kW a year. This project involves building two dams and a 476,000 kW power station at Bathie which will be the most powerful in France.

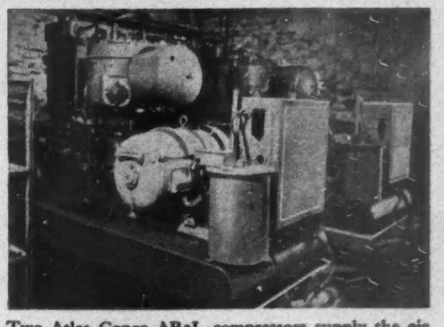
Atlas Copco compressed air equipment is being used almost everywhere on this project. For drilling the main tunnels more than a hundred BBD41WK rock drills with pusher feeds and several thousand Sandvik Coromant drill steels are being used by the main contractors, Borie, Ets. Sinrapt & Brice, Gebro, Pegas & Pugeat, Stribick Et Fils.

Sales and Service in ninety countries

Atlas Copco is the world's largest organisation specialising solely in compressed air equipment. Products include stationary and portable compressors, rock drills, loaders and air tools and equipment of every description. Wherever you are, the international Atlas Copco group will supply expert advice on the selection of equipment and provide a complete after-sales service.

General view of work on the Roselend Dam.

The Headrace Tunnel will be 13 km in length and 4.2 metres in diameter. Single deck platforms are used for drilling, with four men working on the platform and four on the ground beneath.



Two Atlas Copco AR3L compressors supply the air power at the Versoyen drilling site.

Atlas Copco puts compressed air to work for the world

ATLAS COPCO AB, STOCKHOLM 1, SWEDEN

DSA.1

H

NICKEL ALLOY STEELS

ensure reliability in lifting

The fork lift truck, of which this Diac model is an advanced design, epitomises the transition of labour from man to machine.

This new unit, designed to achieve high operating speeds and quick servicing, incorporates various components made from eight nickel alloy steels, notably EN 33, the tried and proven 3 per cent nickel case-hardening steel long used for services where fatigue is a factor and wear resistance a requirement.

TYPICAL CORE MECHANICAL PROPERTIES OF

EN33

ARE AS FOLLOWS:

SIZE	HEAT TREATMENT	MAXIMUM STRESS t.s.i.	ELONGATION per cent	IZOD ft. lb.
1⅛" dia	Oil quenched 860°C Water quenched 770°C.	56·3	21·5	83
3" dia	Oil quenched 860°C Water quenched 760°C.	47·2	20	92

The benefits to be gained from the more highly alloyed case-hardening nickel steels, such as EN 33, EN 34, EN 36 and EN 39 include ease of heat-treatment, minimisation of processing distortion, and general reliability.

Please send for our publications entitled, 'The Mechanical Properties of Nickel Alloy Steels' and 'The Case Hardening of Nickel Alloy Steels'.

MOND NICKEL

THE MOND NICKEL COMPANY LIMITED · THAMES HOUSE · MILLBANK · LONDON · SW1

TGA 21/2P

He's a casting director of many parts...

... and the results of his work give excellent performance.

For, whatever casting process is required for *your* production—cement-sand, shell-moulding or 'lost-wax'—the team of experts at David Brown Foundries Division carries it out with supreme skill and care.

There is no proven method of casting that is not within the scope of the division's resources. There is no recognised technique of testing that is not used at Penistone. Inspection by X- and gamma-radiography, by photo-electric absorptiometer and by spectrograph, are standard. Electromagnetic flaw detection is applied to all steel castings for aircraft and other special applications.

You can SAFELY *specify David Brown castings.*

DAVID BROWN

100 YEARS 1860-1960

THE DAVID BROWN CORPORATION (SALES) LIMITED
Foundries Division, Penistone, Nr. Sheffield. Telephone: Penistone 3311

OA/562

H2

HAMMERED OR HYDRAULIC PRESSED

FORGINGS

IN STEEL BLACK OR MACHINED TO 24 TONS

THE INCE FORGE CO. LTD · WIGAN
PARKS FORGE LTD · PROPRIETORS

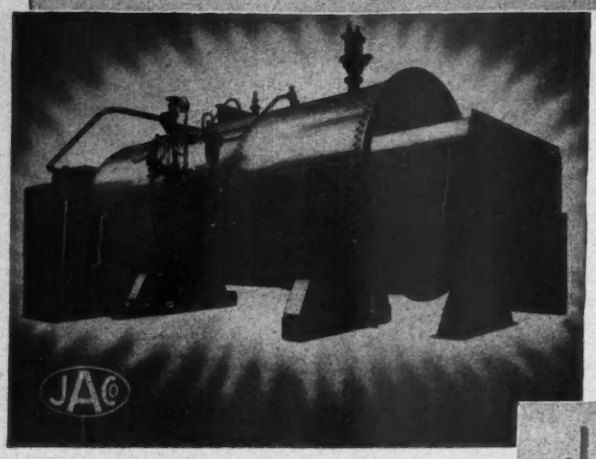
FOR SAFETY & LONG LIFE INSIST ON WROUGHT IRON HAND WELDED

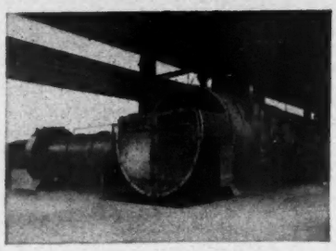
CHAINS

TESTED TO BRITISH STANDARD SPECIFICATIONS
ALL SIZES SUPPLIED FROM STOCK

JONES & LLOYD LTD
SCOTIA WORKS & CRADLEY FORGE
CRADLEY STAFFS

JOSEPH ADAMSON
Waste Heat Boilers





The Joseph Adamson Waste Heat Boiler is designed to make efficient use of the waste gases leaving open-hearth furnaces, reheating furnaces, soaking pits, gas retorts, etc.

The straight-through fire tubes have a high ratio of length to bore, giving about 90% tube efficiency and providing a large area of heating surface in a comparatively small space. Brickwork setting is not required and air infiltration is thus avoided.

A feature of Joseph Adamson Waste Heat Boilers is that a special cleaning device can be provided in the outlet chamber to allow the tubes to be cleaned while the boiler is at work.

JOSEPH ADAMSON & CO. LTD.
P.O. BOX 4 · HYDE · CHESHIRE
in association with
Adamson Alliance Co. Ltd., 165 Fenchurch St., London, E.C.3
The Horsehay Company Ltd., Wellington, Shropshire

THE ADAMSON GROUP

JA 11

Increase production!
by using
SCRIVEN MACHINE TOOLS

CROSTHWAITE FURNACES and
SCRIVEN MACHINE TOOLS LTD.
York Street Ironworks, Leeds 9 Tel.: 32411-2
32, Victoria Street, London, S.W.1 Tel.: Abbey 2966

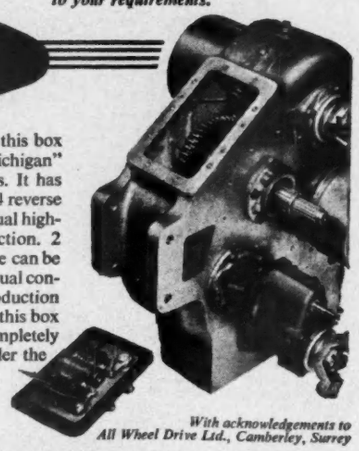
ACCURACY AND QUALITY ON A PRODUCTION BASIS

Produced to your own specification or designed by us to your requirements.

PRECISION GEARING

This divider gearbox is used on a snowplough. It has a single input shaft which transfers the drive to two output shafts through a gear train which gives high and low ratios with manual selection.

3 versions of this box are used on "Michigan" Tractor Shovels. It has 4 forward and 4 reverse gears with manual high-low range selection. 2 or 4-wheel drive can be selected by manual control. Since production started in 1958 this box has proved completely trouble-free under the most arduous conditions.

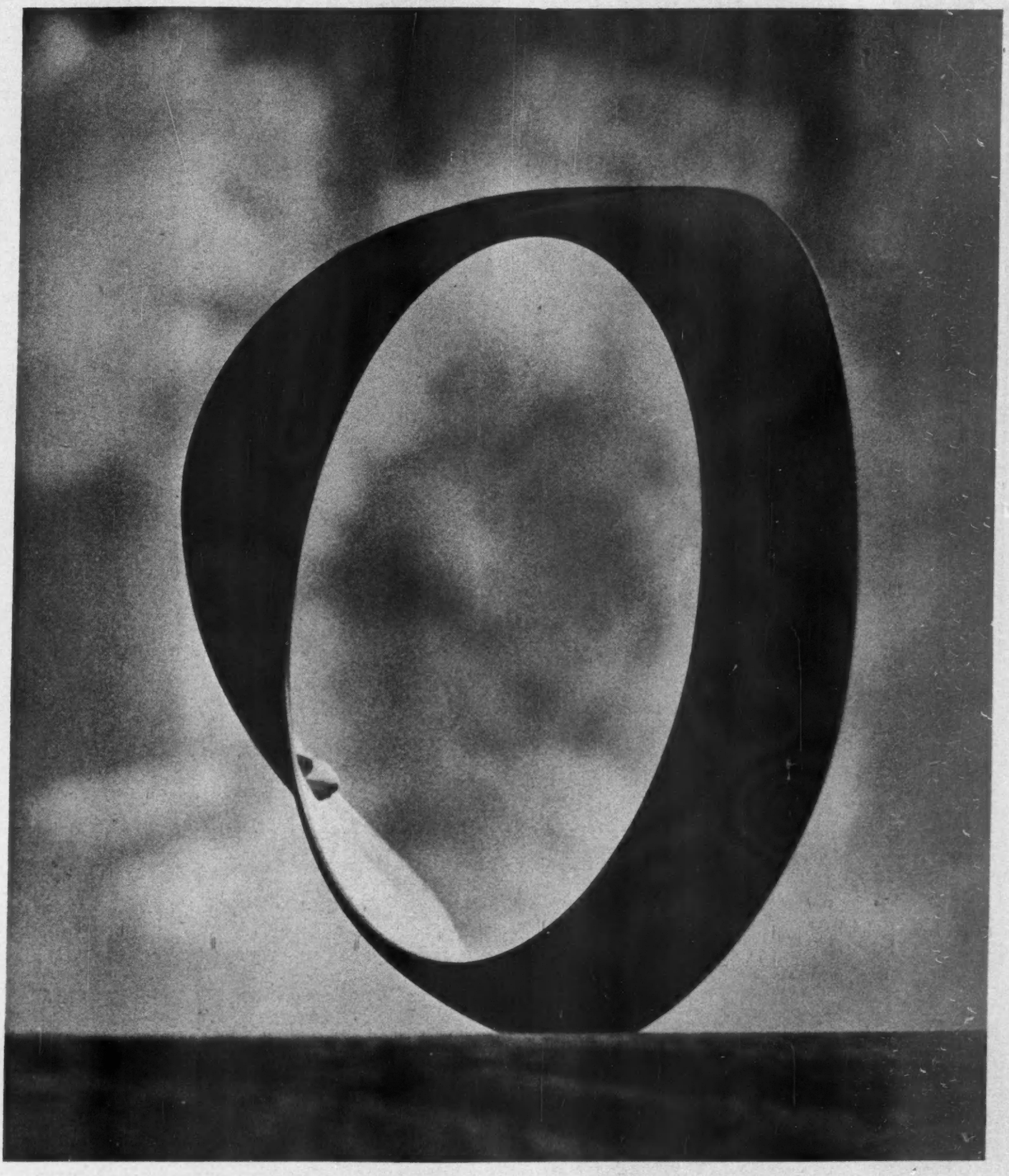


With acknowledgements to All Wheel Drive Ltd., Camberley, Surrey

CENTRAX

CENTRAX LIMITED, Newton Abbot, Devon

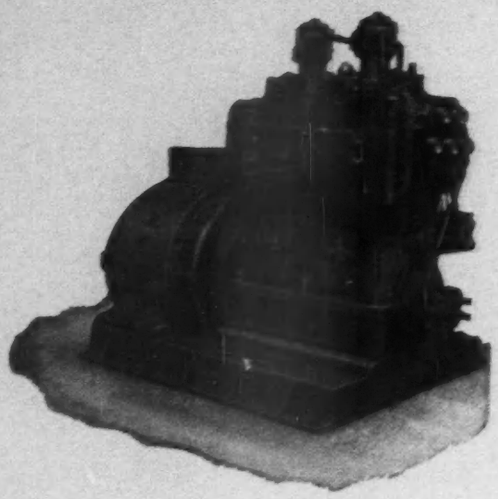
Sales Office: 248-250 Tottenham Court Road, London, W.1. LANgham 2364/5



This headlamp surround for a popular make of car is not a steel pressing but a zinc-alloy pressure die casting. Note the extremely thin sections. Die casting is often the cheapest and quickest way of making many things that do not at first sight suggest casting at all. **Die castings by . . .**

THE BRITISH OXYGEN COMPANY LTD · SPARKLETS WORKS · LONDON N.17 · TEL: TOTTENHAM 0881

AIR COMPRESSORS for DIESEL SHIPS



This shows our latest 3-stage Vertical Enclosed Marine Type Diesel Auxiliary Compressor, with Forced Lubrication, direct coupled to an Electric Motor. Machines may also be arranged for Steam Driving, and have either one or two cranks, depending on the output.

For full particulars write to Dept. B.

REAVELL & CO., LTD

Telegrams: REAVELL, IPSWICH
Telephone Nos: Ipswich 50126 (3 lines)

IPSWICH

CHESTERFIELD

FIRST WITH BERYLLIUM TUBES NOW

FIRST WITH FINNED BERYLLIUM TUBES

FIRST BERYLLIUM CHESTERFIELD TUBE CO. LTD. ENGLAND

This is 0.295"B with wall thickness of 0.040"
It has 18 radial fins 0.040" wide x 0.060" high

THE CHESTERFIELD TUBE COMPANY LIMITED · CHESTERFIELD

A MEMBER OF THE Ti GROUP

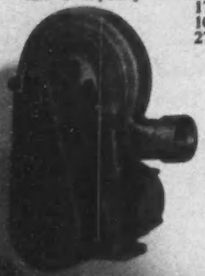
Speed up your production with

Secomak REG°

HIGH PERFORMANCE

BLOWERS & SUCTION UNITS

There's plenty of High velocity air for industrial purposes with 'Secomak' blower and suction units in a variety of capacities. Light in weight and compact, the model illustrated measures only 12in. square by 20in. high and is powered by continuously rated A.C. induction motor, but it has a capacity of 300 c.f.m. at 17in. w.g. to 100 c.f.m. at 27in. w.g.

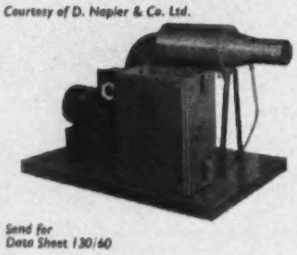


Send for range and data sheets 104, 132, HV 100.

HOT AIR BLOWERS

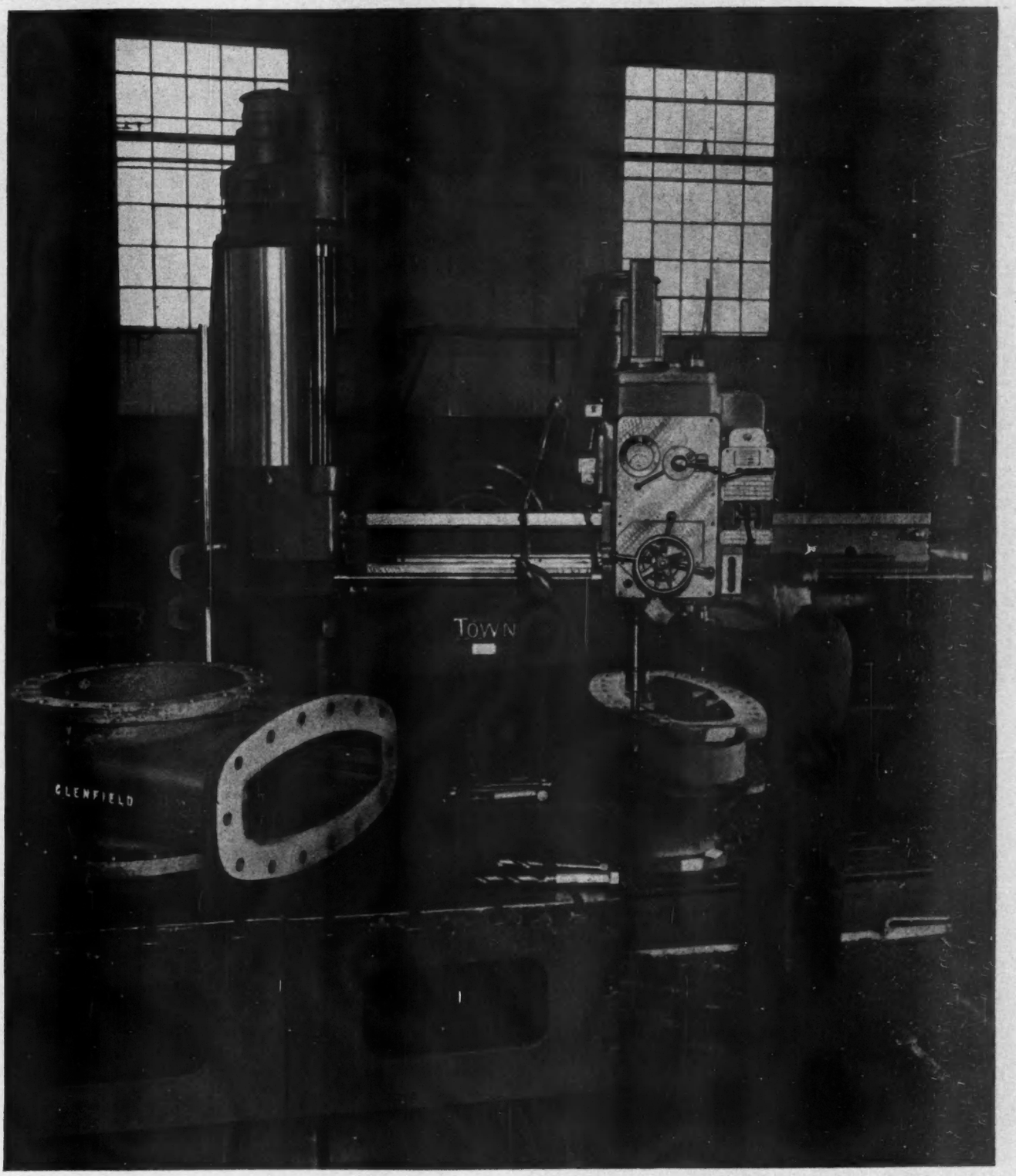
Increased efficiency is assured with 'Secomak' Hot Air Blowers in many industrial processes requiring heat for drying or conditioning. Transportable model illustrated incorporates fan delivering 750 c.f.m. and heater loadings up to 18 kW with automatic temperature control. Hot Air equipment from units weighing only a few pounds complete with blower, in a wide practical range.

Courtesy of D. Napier & Co. Ltd.



Send for Data Sheet 130/60

SERVICE ELECTRIC CO. LTD.
POT LANE · STANMORE · MIDDX. Tel: EDGware 5566-9



GLENFIELD & KENNEDY, LIMITED, are highly satisfied with their TOWN 8ft. C.E.2. Heavy Radial Drilling Machine with Right Angle Baseplate, which has centralised control and drills 3¼in. from solid in mild steel and cast Iron.

Other sizes available.
Write for folder 'Go To Town.'

FRED^K TOWN & SONS LTD

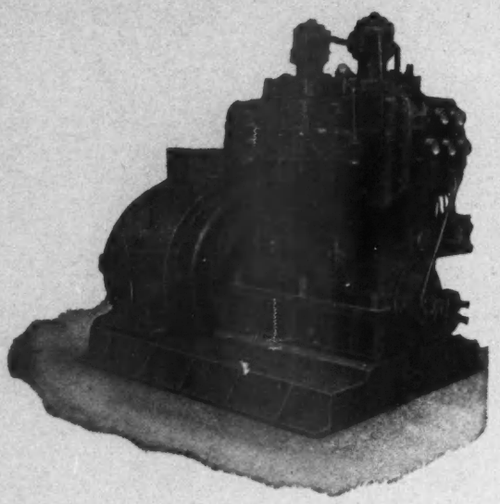
MAKERS OF HIGH CLASS DRILLING MACHINES FOR 58 YEARS

HALIFAX · YORKS

PHONE: HALIFAX 60373/4

T.25

AIR COMPRESSORS for DIESEL SHIPS



This shows cur latest 3-stage Vertical Enclosed Marine Type Diesel Auxiliary Compressor, with Forced Lubrication, direct coupled to an Electric Motor. Machines may also be arranged for Steam Driving, and have either one or two cranks, depending on the output.

For full particulars write to Dept. B.

REAVELL & CO., LTD

Telegrams: REAVELL, IPSWICH
Telephone No.: Ipswich 56124 (3 lines)

IPSWICH

CHESTERFIELD

FIRST WITH BERYLLIUM TUBES NOW

Speed up your production with

Secomak REG°

HIGH PERFORMANCE

BLOWERS & SUCTION UNITS

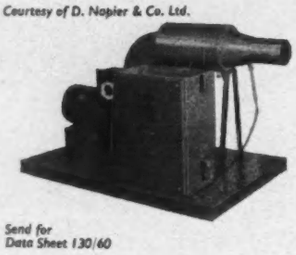
There's plenty of High velocity air for industrial purposes with 'Secomak' blower and suction units in a variety of capacities. Light in weight and compact, the model illustrated measures only 12in. square by 20in. high and is powered by continuously rated A.C. induction motor, but it has a capacity of 300 c.f.m. at 17in. w.g. to 100 c.f.m. at 27in. w.g.

Send for range and data sheets 104, 132, HV 100.

HOT AIR BLOWERS

Increased efficiency is assured with 'Secomak' Hot Air Blowers in many industrial processes requiring heat for drying or conditioning. Transportable model illustrated incorporates fan delivering 750 c.f.m. and heater loadings up to 18 kW with automatic temperature control. Hot Air equipment from units weighing only a few pounds complete with blower, in a wide practical range.

Courtesy of D. Napier & Co. Ltd.



Send for Data Sheet 130/60

SERVICE ELECTRIC CO. LTD.
HONEYPOT LANE · STANMORE · MIDDX. Tel: EDGware 5566-9

FIRST WITH FINNED BERYLLIUM TUBES

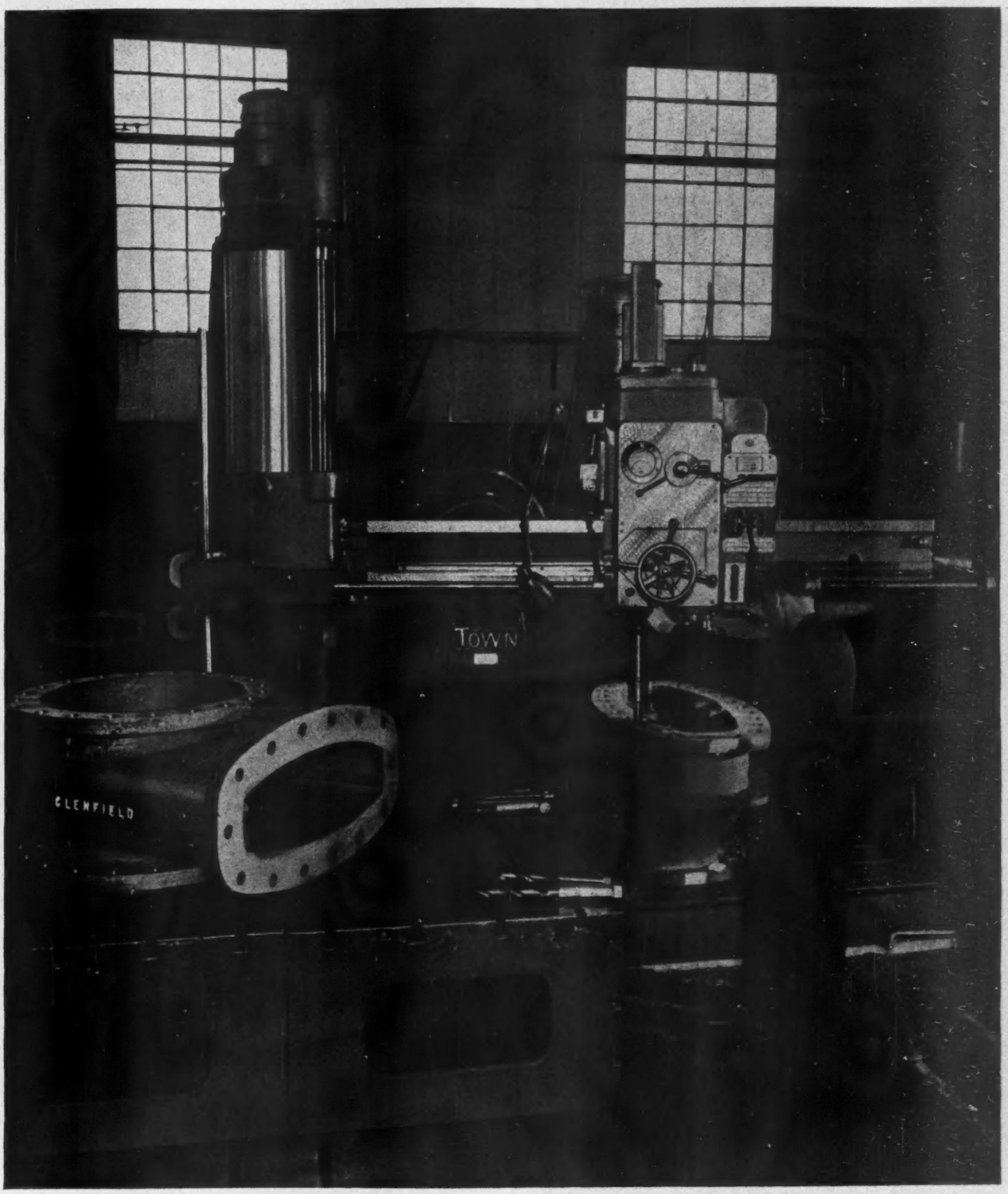
FIRST WITH BERYLLIUM CHESTERFIELD TUBE CO. LTD. ENGLAND

This is 0.295"B with wall thickness of 0.040"
It has 18 radial fins 0.040" wide x 0.060" high

THE CHESTERFIELD TUBE COMPANY LIMITED · CHESTERFIELD

A MEMBER OF THE TI GROUP

CTC69



GLENFIELD & KENNEDY, LIMITED, are highly satisfied with their TOWN 8ft. C.E.2. Heavy Radial Drilling Machine with Right Angle Baseplate, which has centralised control and drills 3½in. from solid in mild steel and cast iron.

Other sizes available.
Write for folder 'Go To Town.'

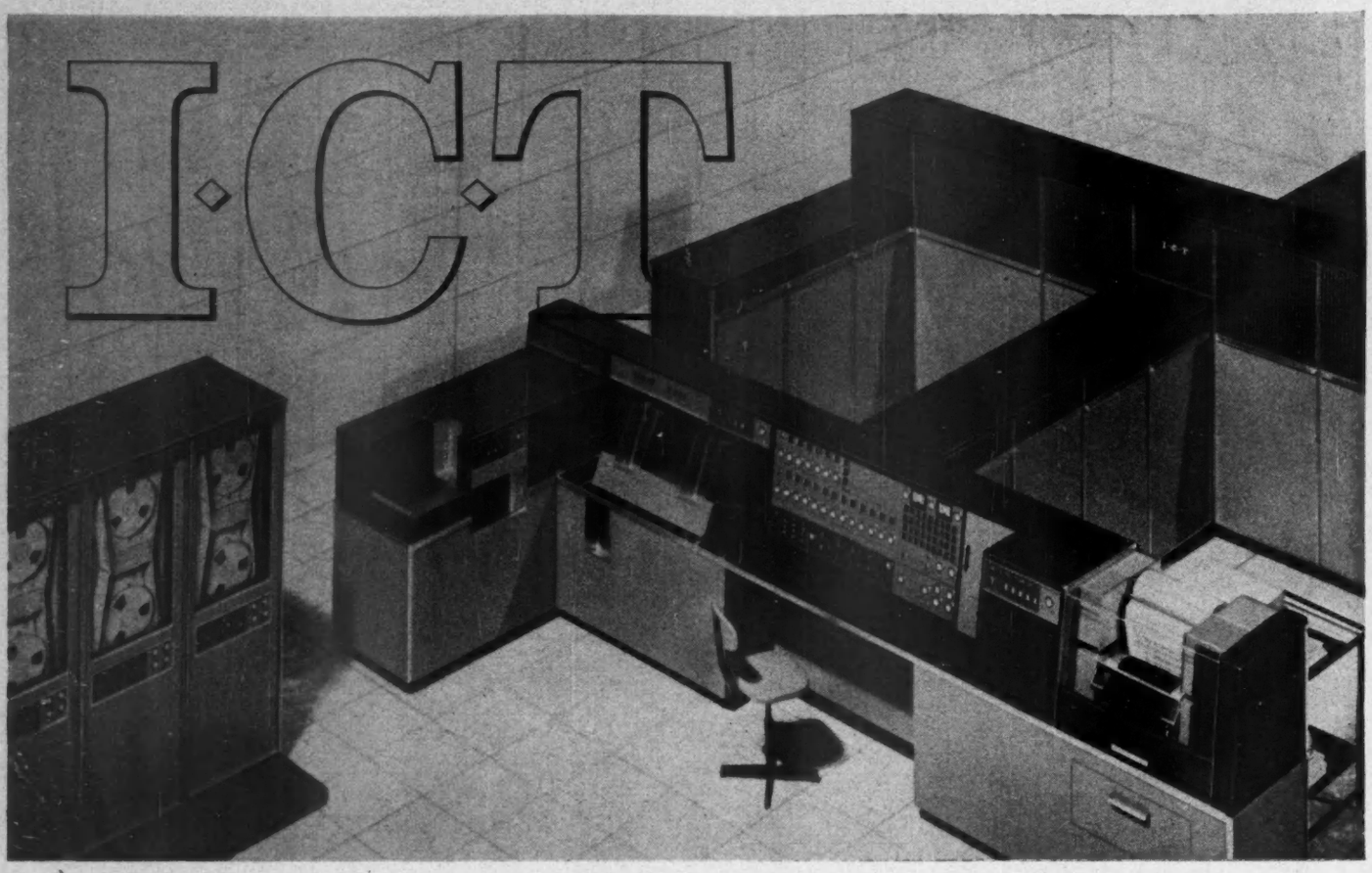
FRED^K. TOWN & SONS LTD

MAKERS OF HIGH CLASS DRILLING MACHINES FOR 58 YEARS

HALIFAX · YORKS

PHONE: HALIFAX 60373/4

T.25



No words, no specification, can capture the real quality of a computer

A computer is the sum of the thinking, the engineering, the experience that go into its making, *plus* the accumulated skills that go into its applications and servicing.

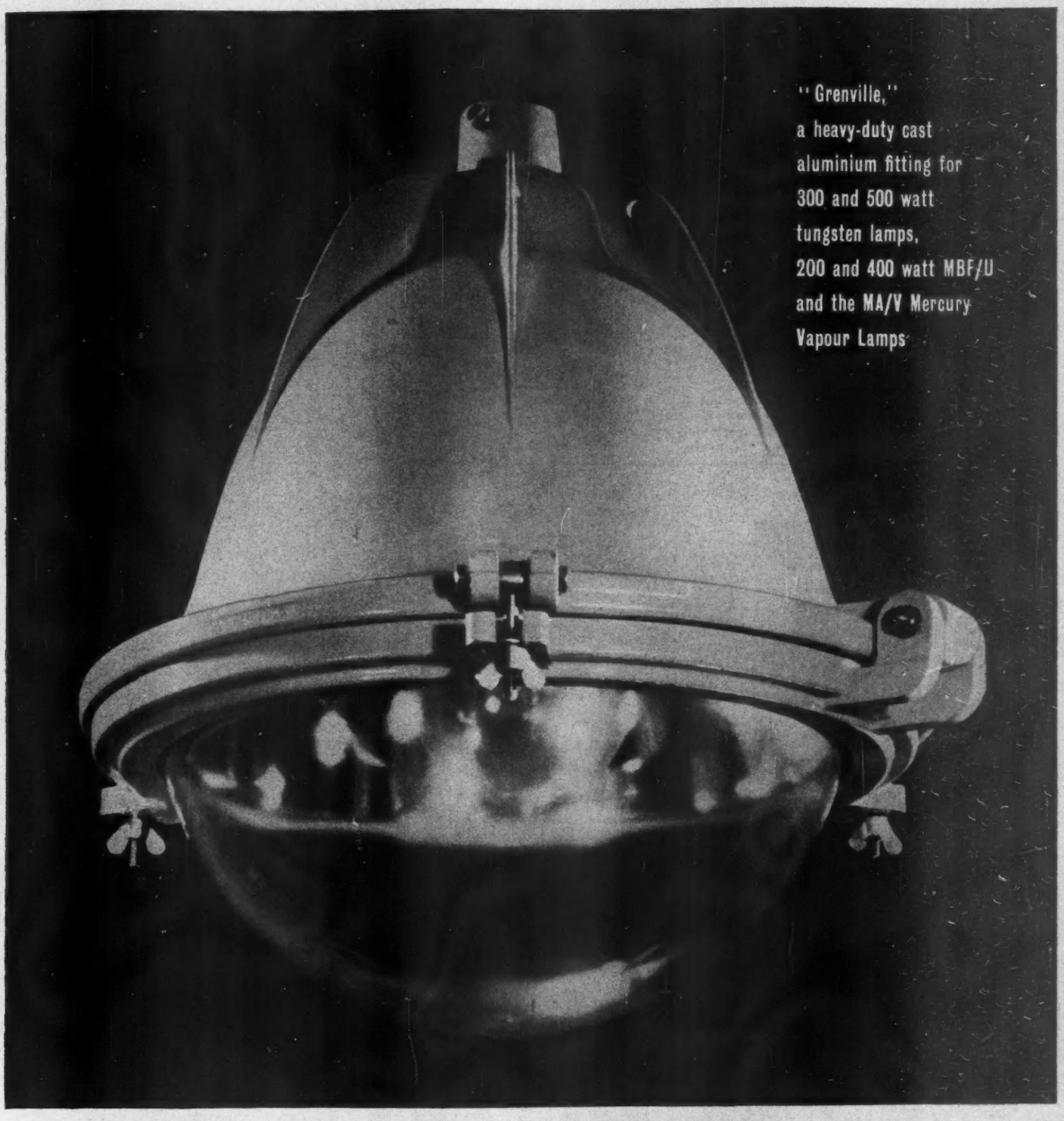
On all these scores, I·C·T has no equal in Britain. I·C·T, with over 50 years' experience of data processing, has made more than half the computers in commercial use here today. I·C·T in Britain is deployed over 23 factories, 31 area offices, 3 research establishments, and 5 educational and training centres for customers' staff. World-wide, I·C·T employs 19,000 people and operates in 51 countries, I·C·T's service is at *your* service from the moment of your first enquiry.

The computer illustrated is the 1301. It is a product of I·C·T and G.E.C. and their jointly owned Computer Developments Limited. A comprehensive booklet on the 1301 can be had on request.

I·C·T

International Computers and Tabulators Limited

149 PARK LANE, LONDON W1. TEL: HYDE PARK 8080



FALKS "Grenville" makes light of arduous conditions

Equipment that is exposed to the full rigours of British weather and industrial atmospheres has to be tough to survive. FALKS Grenville is tough—it's resistant to vapour, dust and weather—hose-proof and highly resistant to corrosion. It makes light of difficult conditions. Grenville is a must for docks, gasworks, railways, steelworks and chemical works.

FALKS, the long-established lighting specialists, designers and manufacturers of all types of fittings. Lighting Engineering Services freely available.

FLOATING HINGE AND CAPTIVE SCREWS ENSURE DUST-PROOF JOINT

We invite your inquiries

FALKS
FALK, STADELMANN & CO. LTD.

THERE'S A MODERN FALKS FITTING FOR EVERY PURPOSE

91, FARRINGDON ROAD, LONDON, E.C.1. HOLborn 7654 London Showrooms: 20/22 MOUNT STREET, PARK LANE, W.1 MAYfair 5671/2

AP116

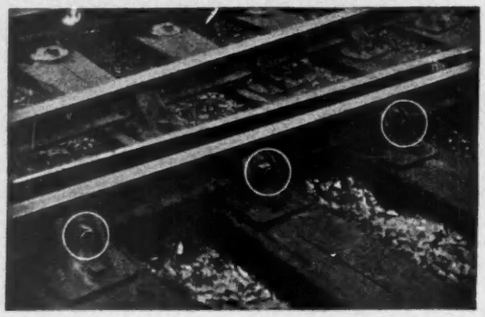
PALNUT SAFETY LOCK WASHERS
for all loose nut problems

"PALNUT" IN SERVICE.

PERMANENT, ECONOMICAL, EFFICIENT, For
FISHPLATES, LOCOMOTIVES, SIGNALS, FOULING BARS, CARRIAGES AND WAGONS, POINT GEAR, TURNTABLES AND ALL MACHINERY SUBJECT TO VIBRATION.

100% DID NOT FAIL!

By courtesy of the Chief Civil Engineers Office (Western Region) British Railways. We shew "PALNUTS" fitted on the permanent way.



Extract from The National Physical Laboratory Report

Conclusions

The "Palnut" locking device did not fail during tests lasting in all 83 hours during which the oscillator made 6,298,000 cycles although during the run 27 bolts and one bar of the frame were fractured. Measurement of the torque required to loosen the nuts after test gave an average torque slightly in excess of that required to slacken bolts which had not been subject to vibration.

THE PALNUT COMPANY LIMITED
Palnut Works, Arthur Street, Hove 3, Sussex
Telephone: HOVE 70427. Telegrams: PALNUT HOVE

M and I Silicone Glass Laminates are available in these grades

S9 SILICONE GLASS PAXOLIN complying with DEF-5000 type S.1.

S5 SILICONE GLASS PAXOLIN having superior machining characteristics. This grade complies with DEF-5000 type S.1. except for impact strength.

M & I are specialists in silicone electrical insulation for Class "H" applications

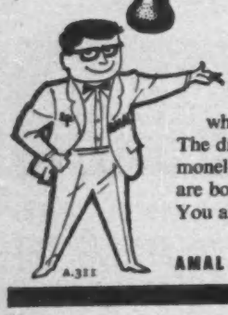
We supply:–
Silicone Empire varnished glass.
Silicone elastomer coated glass fabric tapes.
Silicone bonded mica tape.
Silicone bonded mica glass sheets.
Silicone bonded flexible Micanite
Silicone bonded hard Micanite
Silicone commutator insulation.
Silicone combination insulation.
Silicone glass sleeving.
ENQUIRIES ARE INVITED.

m and i **the electrical insulation people**

THE MICANITE & INSULATORS CO., LTD.,
Blackhorse Lane, Walthamstow, London, E.17. Tel: Larkswood 5500. Grams: Mytilite, London, Telex. Telex: 25183

"PAXOLIN" is a registered trade name of The Micanite & Insulators Co., Ltd.

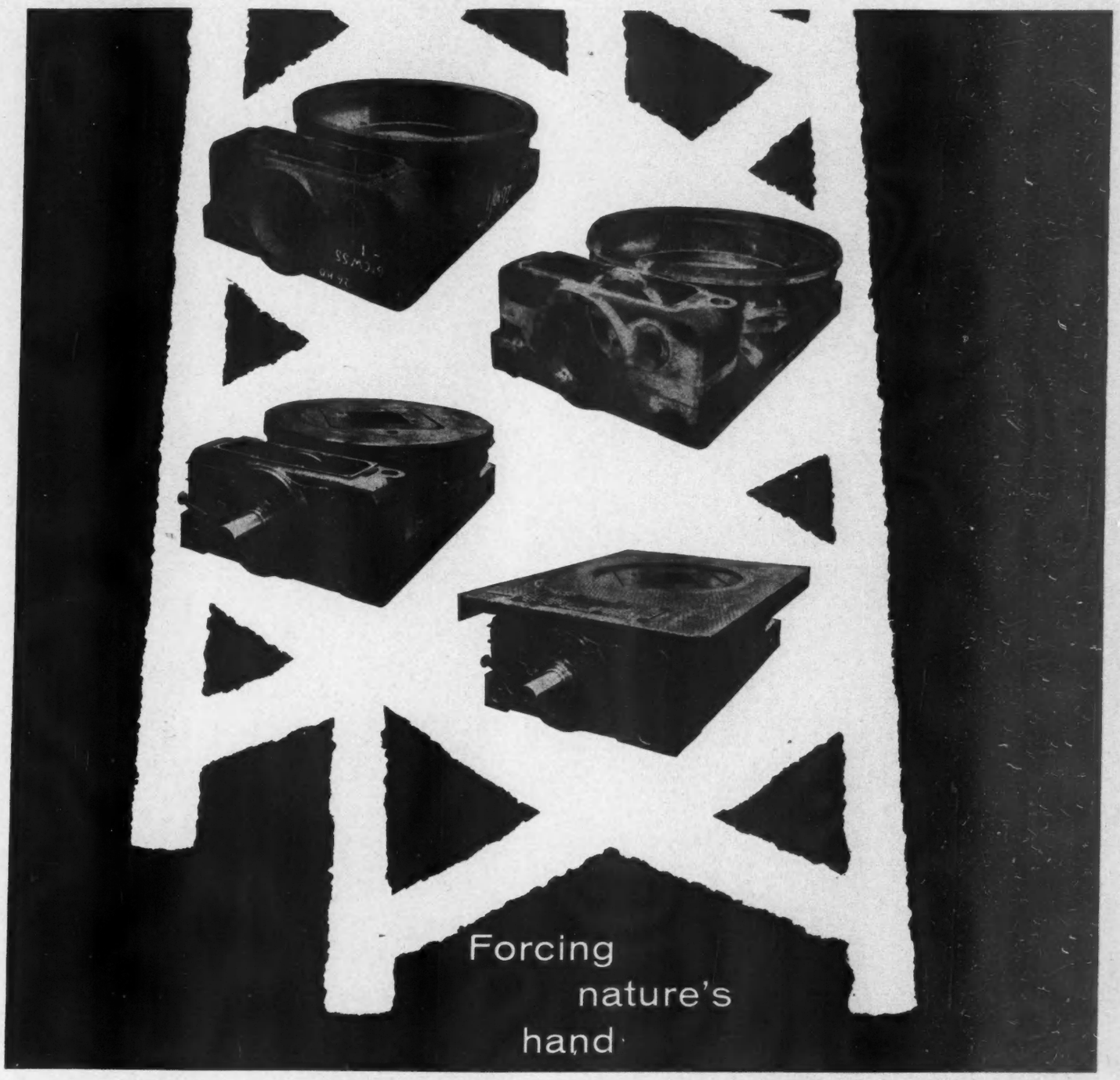
AMAL FILTERS for FUEL OILS



The problem of finding just the right filter is always a difficult one. However, we can help you—the answer is AMAL type 166.
This is a highly efficient and durable mechanism, ideally suited to jobs where accessibility and all round strength are of prime importance.
The dimensions of the 166 are 3¼" diameter x 6⅜" deep. The filtering element is a monel-metal cloth or gauze, the size of the mesh depending on the filtrate. There are bolt holes provided in the top cover for attachment to main unit.
You are invited to write for list No. 303/1 for full details and specifications.

AMAL LTD., HOLDFORD ROAD, WITTON, BIRMINGHAM. Tel: Birchfields 4571

FILTERING ELEMENT



Black Gold—OIL, Man's priceless heritage is locked away in the Earth's deepest places. From the first drilling stage to the final refining phase, 'A.W.' Steel Castings play vital roles in releasing it from the crushing pressure of Nature's depths.

CASTING SPECIALISTS WHO SERVE THE WORLD OF OIL

● Drawworks & Drives ● Swivels ● Crown Blocks ● Travelling Blocks ● Slush & General Service Pumps ● Plunger Pumps for Acidizing, Cementing, Formation Fracturing, Water Flooding, Salt Water Disposal and Refinery Operations.

Armstrong Whitworth (Metal Industries) Ltd.
Western Road Works, Jarrow, Co. Durham. Telephone: Jarrow 89-7111

Subsidiary Company of Armstrong Whitworth (Metal Industries) Ltd.
Close Works, Gateshead upon Tyne, 8

MORGANITE CARBON

There's nothing quite like it . . .

. . . that's the beauty of it

Look at these advantages — Light as aluminium. High resistance to wear. Wide range of resistance to chemical attack. Easily machined. High thermal conductivity. Excellent heat radiation. Not wetted by molten metal or slags. Non-seizing. Self-lubricating. High resistance to thermal shock. Good mechanical strength at high temperatures. Good electrical conductivity. Available in impervious forms. Low thermal expansion. These properties give Morganite Carbon vast potentialities for the design engineer. Talk them over with our technical staff.

The illustration shows a Rectifier Control Grid, a Rectifier Anode, a Boat, a Bearing, two Gland Rings, a Piston Ring, a Tube and a Valve Anode—just a small selection of products showing the remarkable versatility of Morganite Carbon.

MORGANS

CARBON AND GRAPHITE—ELECTRICAL, CHEMICAL AND MECHANICAL; CRUCIBLES, FURNACES, REFRACTORIES; RADIO PARTS, SINTERED METAL PRODUCTS AND ELECTRIC FURNACE ELEMENTS.

THE CARBON DEPARTMENT,

THE MORGAN CRUCIBLE COMPANY LTD., BATTERSEA CHURCH ROAD, LONDON, S.W.11. BAT: 8822

C 58A/416

Spiro-Gills Ltd. are well equipped and experienced to make all types of complete heat exchanger assemblies—including of course, coolers and refrigerating condensers—for use in every industry. Whatever the application, the medium or the conditions, our expert knowledge can undoubtedly save you time and money.

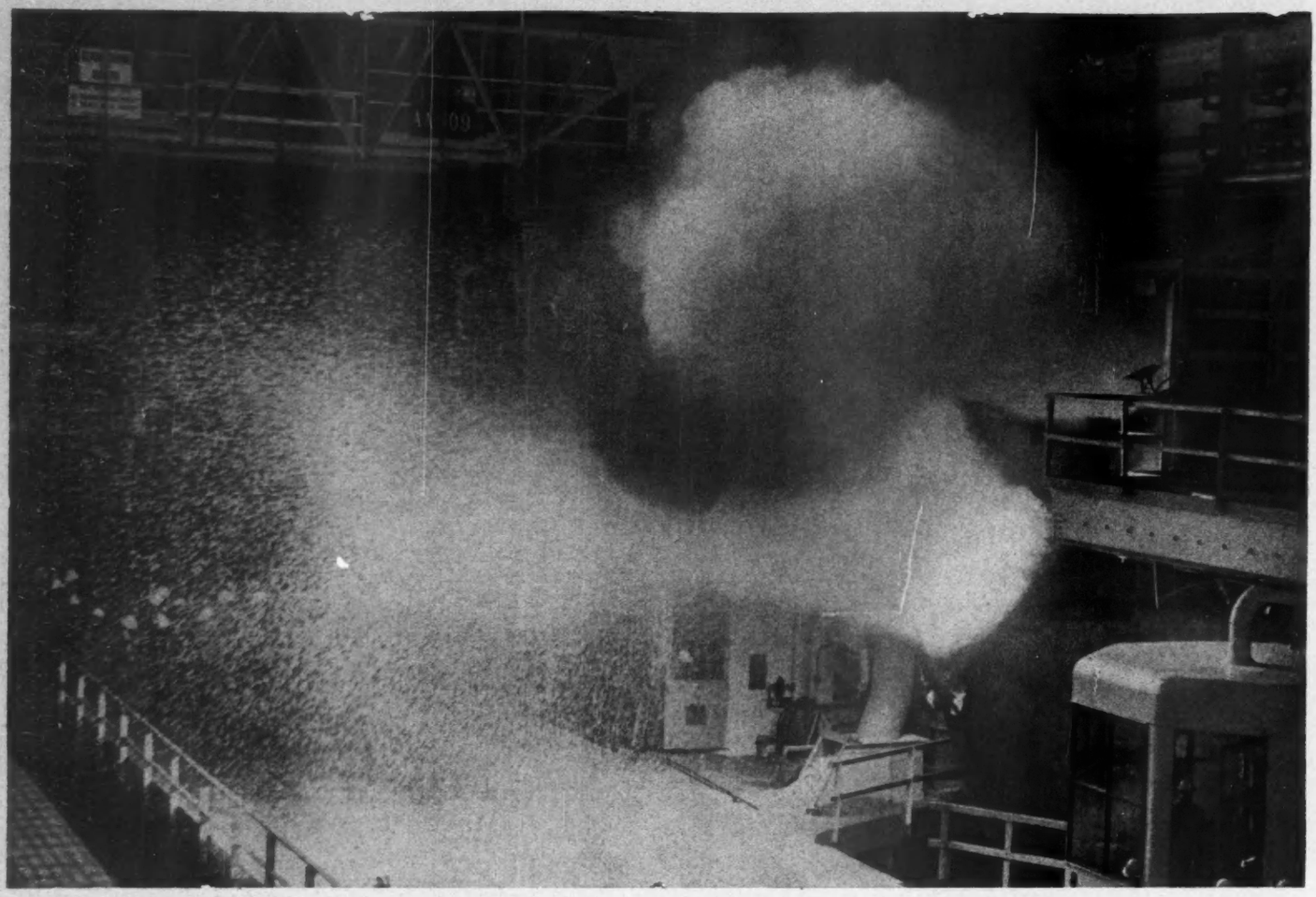
If for example, you have in mind an experimental project requiring heat transfer equipment we will gladly

(a) supply a complete assembly made to your drawings,
(b) design and supply a complete assembly to give any desired performance, or
(c) supply the necessary SG gilled tubing to any required specification.

Our Technical Department is at your service. Full facilities are available for inspection by Lloyds, Boiler Insurance Companies and Consulting Engineers to British and American Codes of Inspection.

SG

SPIRO-GILLS LTD
London Road · Pulborough
Sussex · *Pulborough* 2401/5



Honeywell sparks further progress in Oxygen Enrichment

Smelting times are being cut considerably by the use of controlled oxygen enrichment techniques at the works of the Steel Company of Wales Ltd

THE STEEL COMPANY OF WALES are achieving impressive steelmaking performances by using modern methods of oxygen enrichment of furnace fuel. The technique is being applied to open-hearth furnaces and Bessemer converters.

ACCURATE RECORDS of oxygen quantities are essential to the success of the technique.
This important task is entrusted to Honeywell equipment. Their instruments measure and record the total amount of oxygen used at S.C.O.W.

MODERN STEELMAKING TECHNIQUES require the kind of control instruments for which Honeywell have long been internationally famous—sensitive, robust, accurate and dependable. They have, too, a reputation for commissioning complete systems without trouble.

WRITE OR SEND THE COUPON to:

Honeywell Controls Limited, Ruislip Road East, Greenford, Middlesex. Waxlow 2333.

I am interested in Instrumentation for

_____
(state application)

Name _____

Position _____

Address _____

_____ E

Sales Offices in the principal towns and cities in the United Kingdom and throughout the world.

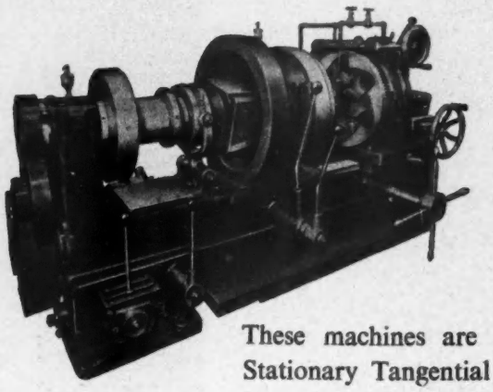
Honeywell

First in Control

SINCE 1885

HEAP'S Rapid Grip

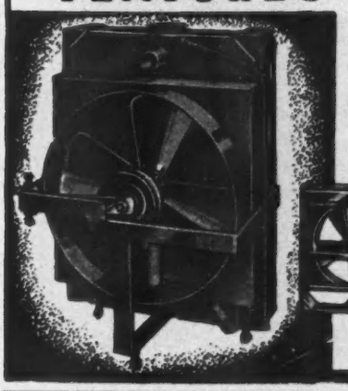
THREADING AND CUTTING MACHINES



These machines are fitted with our Stationary Tangential Die heads and have been designed for production screwing of all sizes of pipes up to 12". They are in use wherever large quantities of piping have to be screwed, e.g. in Tube Works or in the Petroleum Industry. This type of machine can be supplied with 2-in., 4-in., 6-in., 8-in. and 12-in. capacity dieheads.

JOSHUA HEAP & CO., LTD.
ASHTON-UNDER-LYNE · ENGLAND

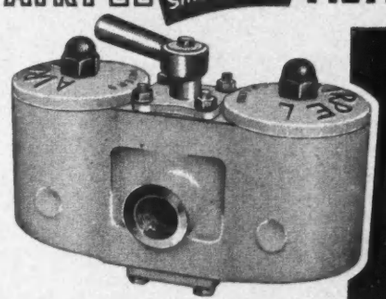
DISTINCTIVE FEATURES of SERKOOL RADIATORS



VIBRATION PROOF
Belt Adjusting Device can be operated without stopping the engine.
Felt Lining attached to the Cowl ensures proper Fan Suction and eliminates metallic vibration and noise.
Cooling Element removed by releasing two bolts.
Write for full particulars and descriptive leaflet.

H. O. SERCK LTD
Sunlight Works, Dilworth Street, Oxford Road, MANCHESTER, 15
Telegraphic Address: "SERCKRAD."
Phone: Ardwick 2776 (3 lines)

AIRPEL SINGLE & DUAL FILTERS FOR FINER FILTRATION OF ALL LIQUIDS



- ★ LARGE CAPACITIES
- ★ LOWEST PRESSURE DROP
- ★ DUAL TYPE GIVES UNINTERRUPTED FLOW
- ★ SINGLE NUT COVER FIXING
- ★ HIGHLY COMPETITIVE

IMMEDIATE EX-STOCK DELIVERIES FROM OUR 11 DEPOTS THROUGHOUT THE U.K. AND EIRE :-

THE BRITISH STEAM SPECIALTIES LIMITED
Head Office: FLEET STREET · LEICESTER
Also at LONDON, LIVERPOOL, GLASGOW, BRISTOL, MANCHESTER, NEWCASTLE-ON-TYNE, BIRMINGHAM, BELFAST, DUBLIN, CARDIFF.
Telephone: LEICESTER 20885 (6 lines) Telegrams: "BOSS" LEICESTER

TO YOUR PRECISE REQUIREMENTS

Whatever your transmission problems we design gears for any power—any speed.

More than 50 years of specialised experience at your service.

THE POWER PLANT COMPANY LIMITED
WEST DRAYTON, MIDDLESEX TEL: WEST DRAYTON 2626 (4 lines) GRAMS: ROC. WEST DRAYTON

COLD WORKING
Forming half rings of 2 in. by 7 in. material to a diameter of 5 ft. on medium power press. Typical of robust Henry Berry design.

METAL FORMING *Machines*

Photos by courtesy of The British Thompson-Houston Co. Ltd. and Engineering

We also manufacture High Pressure Hydraulic Plant for Shipyards, and Railways Workshops, Plate Bending Rolls, Punching and Shearing Machines, Continuous Finishing Presses for Silks and Rayons, Veneer and Plywood Presses, Cotton Baling Presses, Die Spotting Presses, Pumps, Accumulators, Valves and Intensifiers.

HENRY BERRY
& CO., LTD.

CROYDON WORKS, LEEDS, 10.
'PHONE : LEEDS 75481-2
GRAMS : "RIVETTER, LEEDS 10"

HB

Silicon rectifier equipments

for industrial, dockyard and electro-chemical supplies.

A 600 kW silicon rectifier equipment for service in a South African gold mine.

'ENGLISH ELECTRIC' silicon rectifier equipments are available up to the highest outputs for indoor and outdoor service. These equipments are inherently simple and reliable and occupy small space for a given output. The transformer, rectifier and control gear may be purchased as a composite equipment or as separate units.

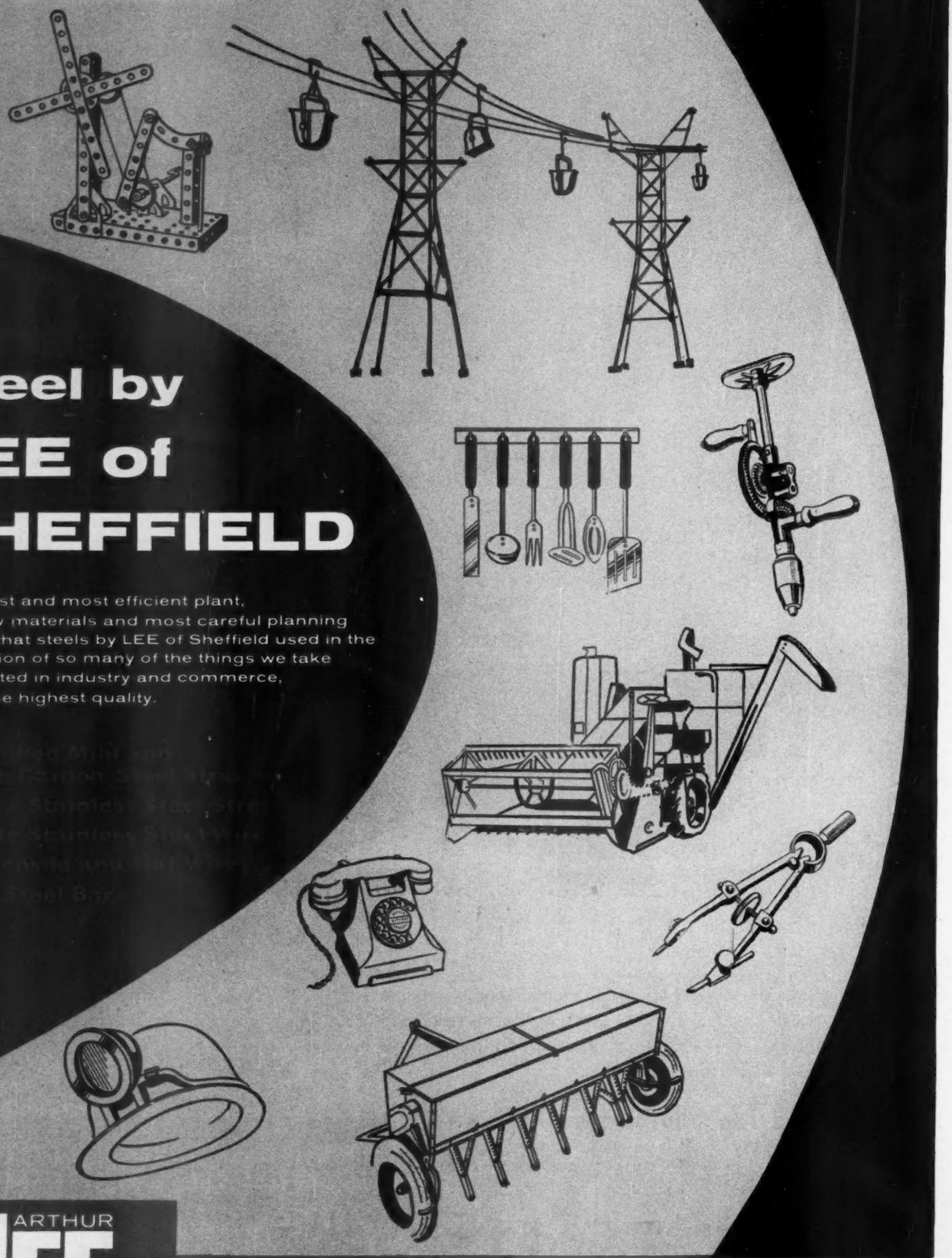
SEND FOR PUBLICATION RS/129 to:
The ENGLISH ELECTRIC Company Limited,
Rectifier Substation Department,
Stafford.

'ENGLISH ELECTRIC'

silicon rectifiers

THE ENGLISH ELECTRIC COMPANY LIMITED, ENGLISH ELECTRIC HOUSE, STRAND, LONDON, W.C.2.
WORKS: STAFFORD · PRESTON · RUGBY · BRADFORD · LIVERPOOL · ACCRINGTON

RS.1.



Steel by LEE of SHEFFIELD

The latest and most efficient plant, best raw materials and most careful planning ensure that steels by LEE of Sheffield used in the production of so many of the things we take for granted in industry and commerce, are of the highest quality.

ARTHUR LEE & SONS LTD

Head Office & Works: Trubrite Steel Works, Meadow Hall, Sheffield. Tel: Sheffield 387272

London Office: Stafford House, 40/43 Norfolk St., Strand, W.C.2. Tel: Temple Bar 7187/8

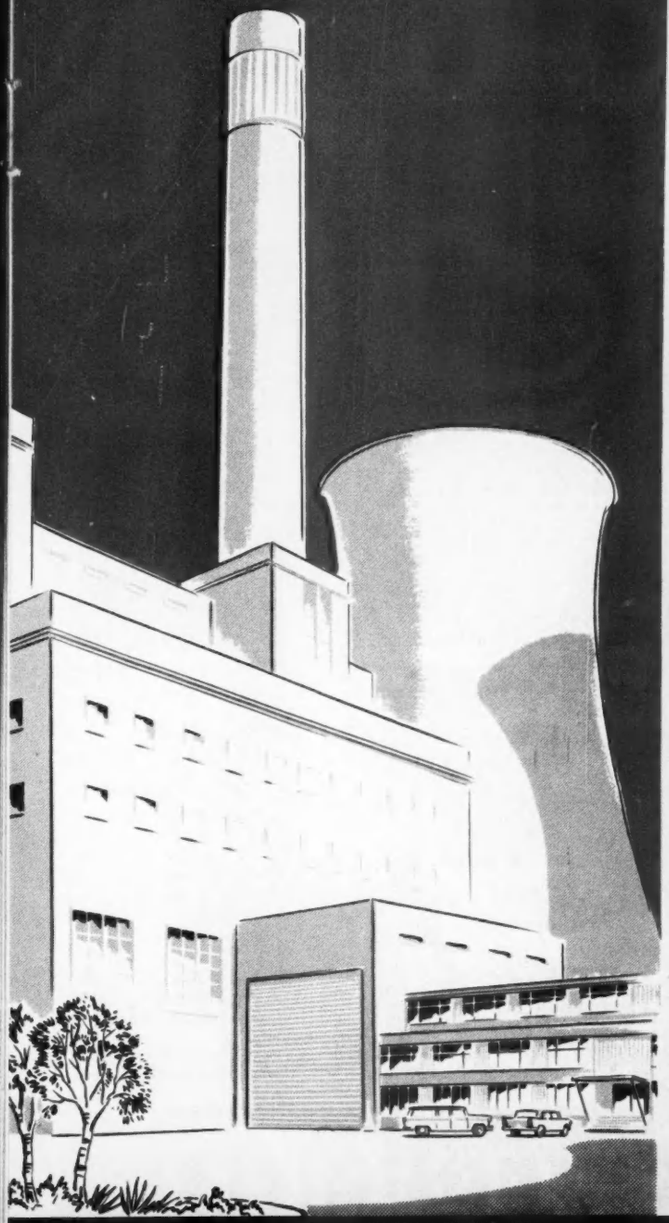
Birmingham Office: 191 Corporation St., Birmingham 4. Tel: Central 6801/2

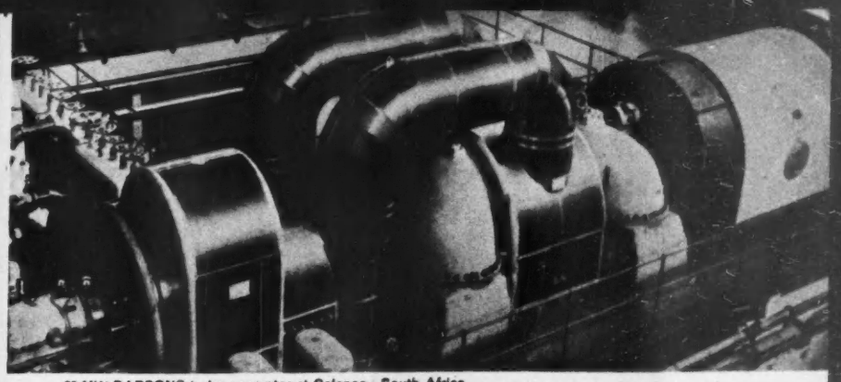
Recent

PARSONS

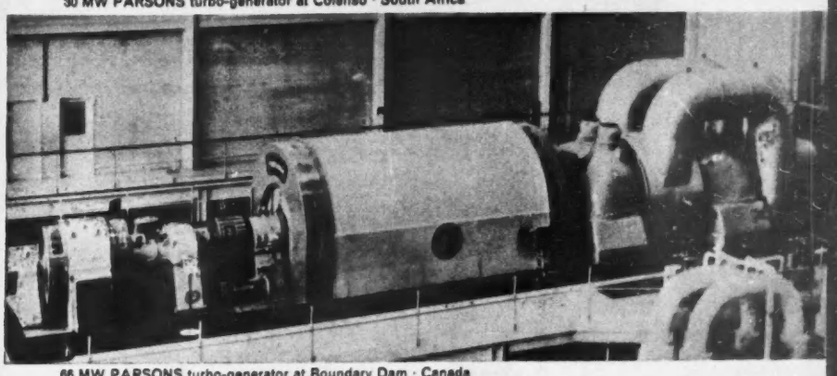
turbo-generator

installations

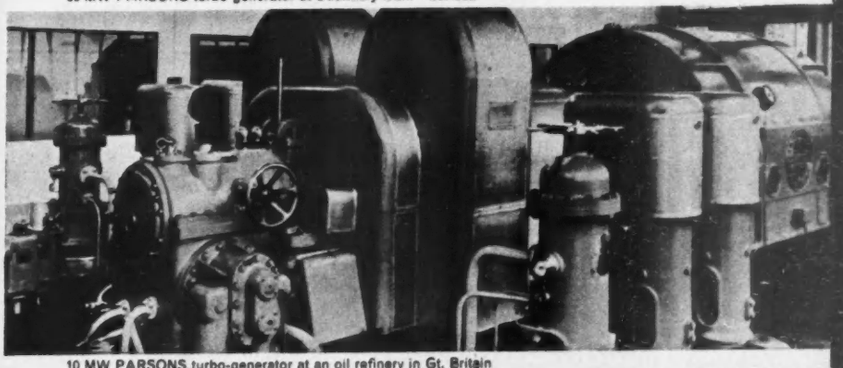




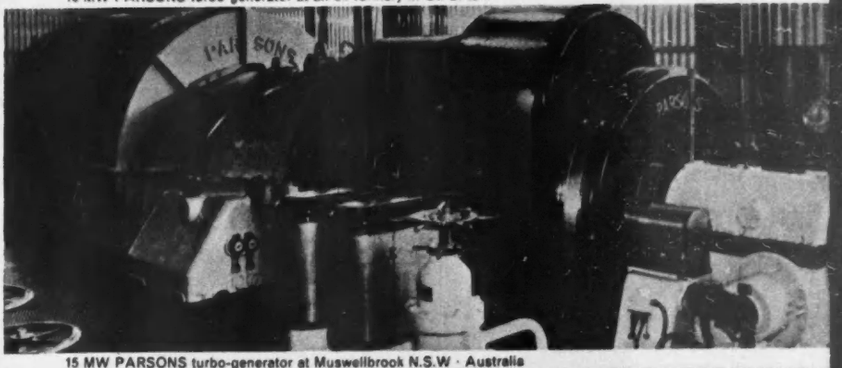
30 MW PARSONS turbo-generator at Colenso · South Africa



66 MW PARSONS turbo-generator at Boundary Dam · Canada



10 MW PARSONS turbo-generator at an oil refinery in Gt. Britain

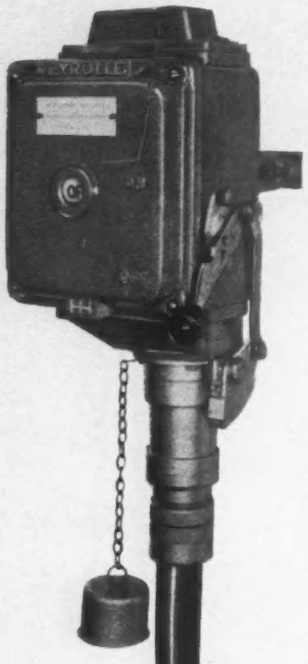


15 MW PARSONS turbo-generator at Muswellbrook N.S.W · Australia

10 MW and 20 MW PARSONS turbo-generator at Trento · Canada

C. A. PARSONS AND COMPANY LTD

HEATON WORKS · NEWCASTLE UPON TYNE



HH
SWITCH AND PLUG UNIT

This new 60-ampere 550-volt switch-and-plug unit is capable of working continuously at full load in heavy industrial conditions and is ideal for controlling welding circuits.

SPECIFICATION

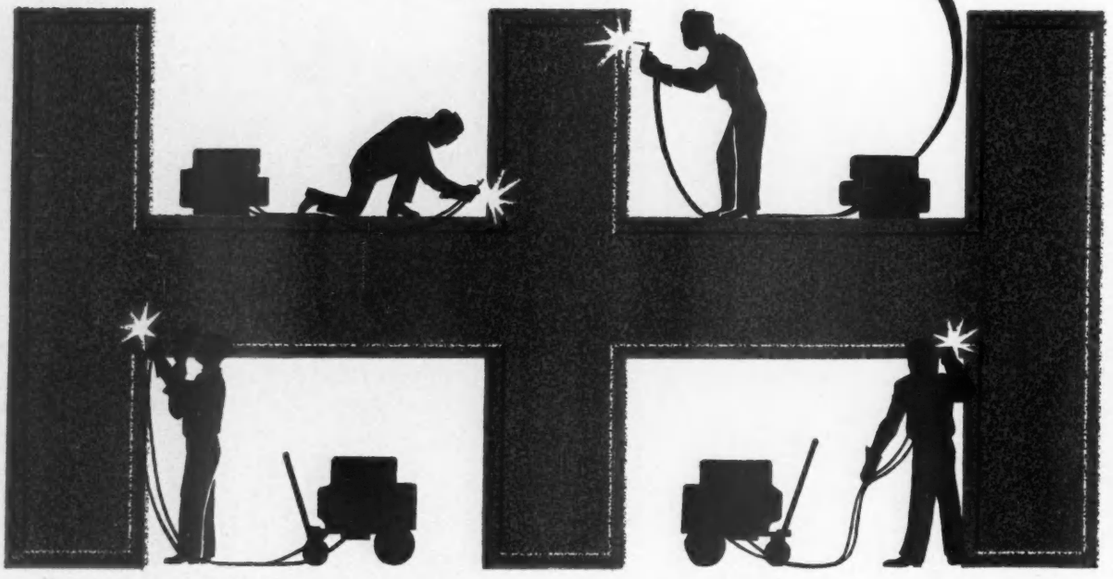
SWITCH: The latest Reyrolle HH design rated at 60 amperes 550 volts and capable of making and breaking current-surges of up to 360 amperes at 0·3 P.F.

PLUG AND SOCKET: A new addition to the Reyrolle "Easigo" range for industrial duty, available for D.P., T.P., or T.P. & N. service with scraping-earth connection.

INTERLOCKS: The switch cannot be closed with the plug withdrawn or the plug removed while the switch is 'ON'.

PROTECTION: An interlocked fuse-unit can be added if required.

Other switch-and-plug units of up to 300-ampere rating are also available.



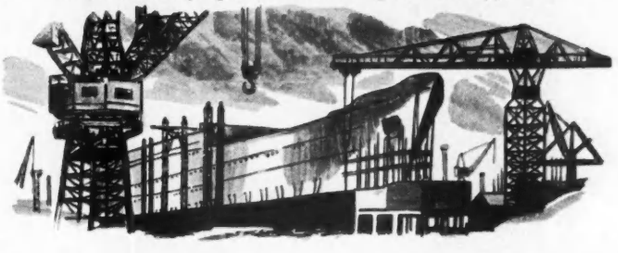
Ask for Pamphlet 1308

Reyrolle

A. REYROLLE & COMPANY LIMITED - HEBBURN - COUNTY DURHAM - ENGLAND

BOOTH CRANES
FOR MODERN SHIPYARDS

Clyde-Booth Monotower cranes are playing an important part in the modernisation programmes of leading British shipyards.



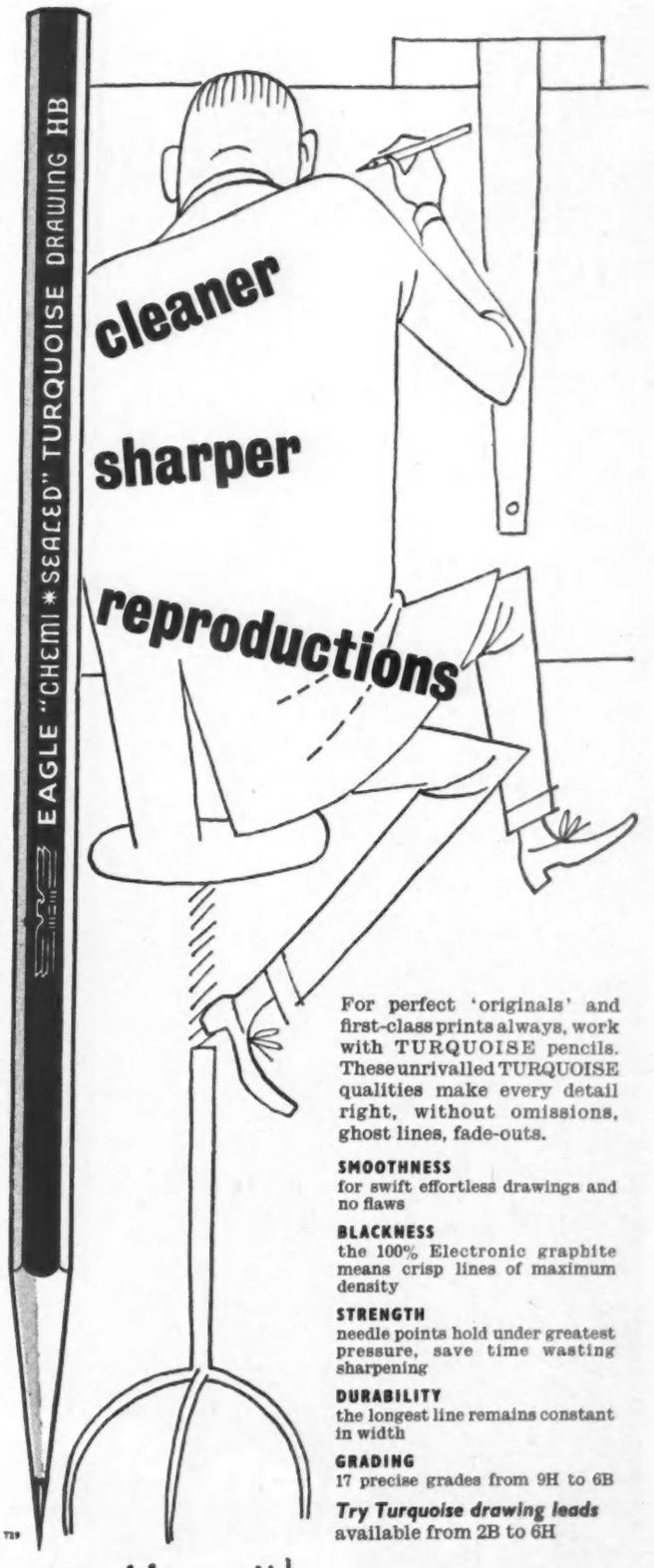
The 35 tons capacity crane illustrated is installed at the Hebburn yard of Messrs. Hawthorn Leslie (Shipbuilders) Ltd., by whose kind permission this photograph is reproduced.

These semi-level luffing cranes are ideally suited to the contemporary trend towards construction in larger prefabricated sections.

CLYDE BOOTH

CLYDE CRANE & BOOTH LTD.
incorporating
Joseph Booth & Bros., Union Crane Works, RODLEY, Leeds. Tel: Pudsey 3168 (6 lines)
'Grams: 'Cranes Rodley, Telex'. Telex: 55159
Clyde Crane & Engineering Co., MOSSEND, Lanarkshire. Tel: Holytown 412 (6 lines)
'Grams: 'Clyde Motherwell, Telex'. Telex: 77443

M



For perfect 'originals' and first-class prints always, work with TURQUOISE pencils. These unrivalled TURQUOISE qualities make every detail right, without omissions, ghost lines, fade-outs.

SMOOTHNESS
for swift effortless drawings and no flaws

BLACKNESS
the 100% Electronic graphite means crisp lines of maximum density

STRENGTH
needle points hold under greatest pressure, save time wasting sharpening

DURABILITY
the longest line remains constant in width

GRADING
17 precise grades from 9H to 6B

Try Turquoise drawing leads
available from 2B to 6H

729

every time with

TURQUOISE pencils

9d each
8/6d per dozen

EAGLE PENCIL COMPANY · ASHLEY ROAD · TOTTENHAM · N.17

At this plant near Kimberley, to produce one lb. of diamonds about 11,000 tons of blue clay have to be worked. Every day, with faultless regularity, thousands of tons of tailings must be carried away. They travel with certainty on M&C conveyors, which are kept efficient by the idlers. These idlers, used for belt conveyors the world over, spin at a touch. They go on keeping out dust, mud, and rain, because they are ***sealed for long life.***

A unit of M&C stringer structure type 2.

MAVOR & COULSON LTD

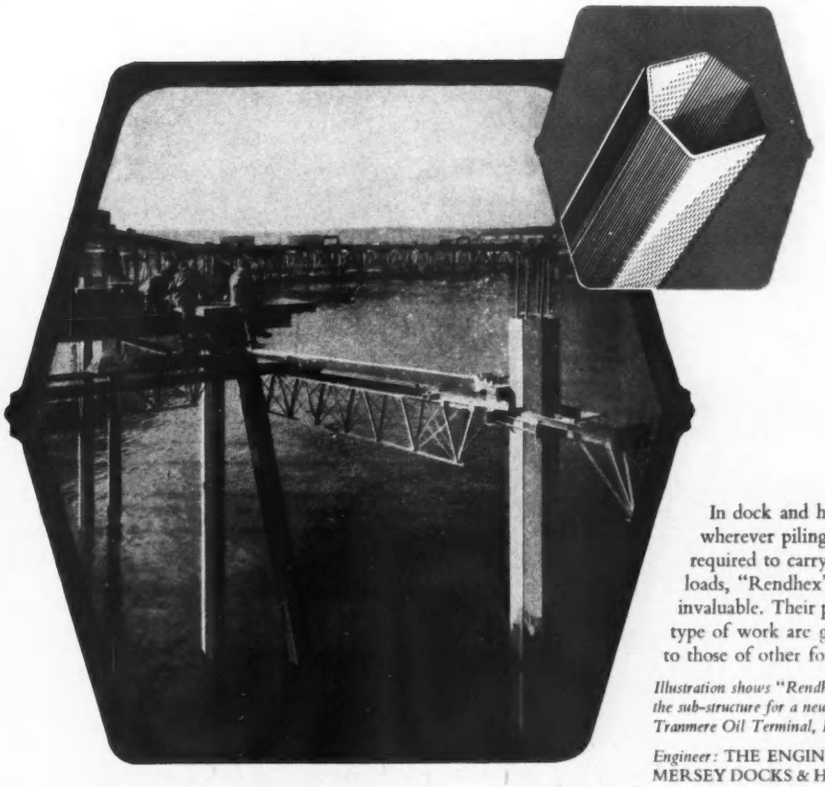
Bridgeton Glasgow S.E.
Olive Grove Road Sheffield 2.
36 Victoria Street London S.W.1.

←One of many M&C conveyors taking the diamond tailings from a central plant to a thrower.

for high efficiency -

M&c conveyors

FOR SECURE FOUNDATIONS IN DEEP WATER AND TIDEWAYS "RENDHEX" FOUNDATION COLUMNS



In dock and harbour installations, wherever piling construction is required to carry heavy vertical loads, "Rendhex" Columns are invaluable. Their properties for this type of work are generally superior to those of other forms of piling.

Illustration shows "Rendhex" Columns forming the sub-structure for a new oil tanker jetty at Tranmere Oil Terminal, Birkenhead.

Engineer: THE ENGINEER-IN-CHIEF, MERSEY DOCKS & HARBOUR BOARD.

Contractors: PETER LIND & CO. LTD.

South Durham STEEL AND IRON COMPANY LIMITED

CENTRAL SALES OFFICE:
CARGO FLEET IRON WORKS, MIDDLESBROUGH, YORKS.
TELEPHONE: MIDDLESBROUGH 46311 (13 LINES)
TELEX: 58551

LONDON OFFICE: SHELL-MEX HOUSE, STRAND, W.C.2.
TELEPHONE: COVENT GARDEN 1181/6.
TELEX: 22480

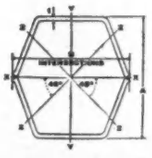
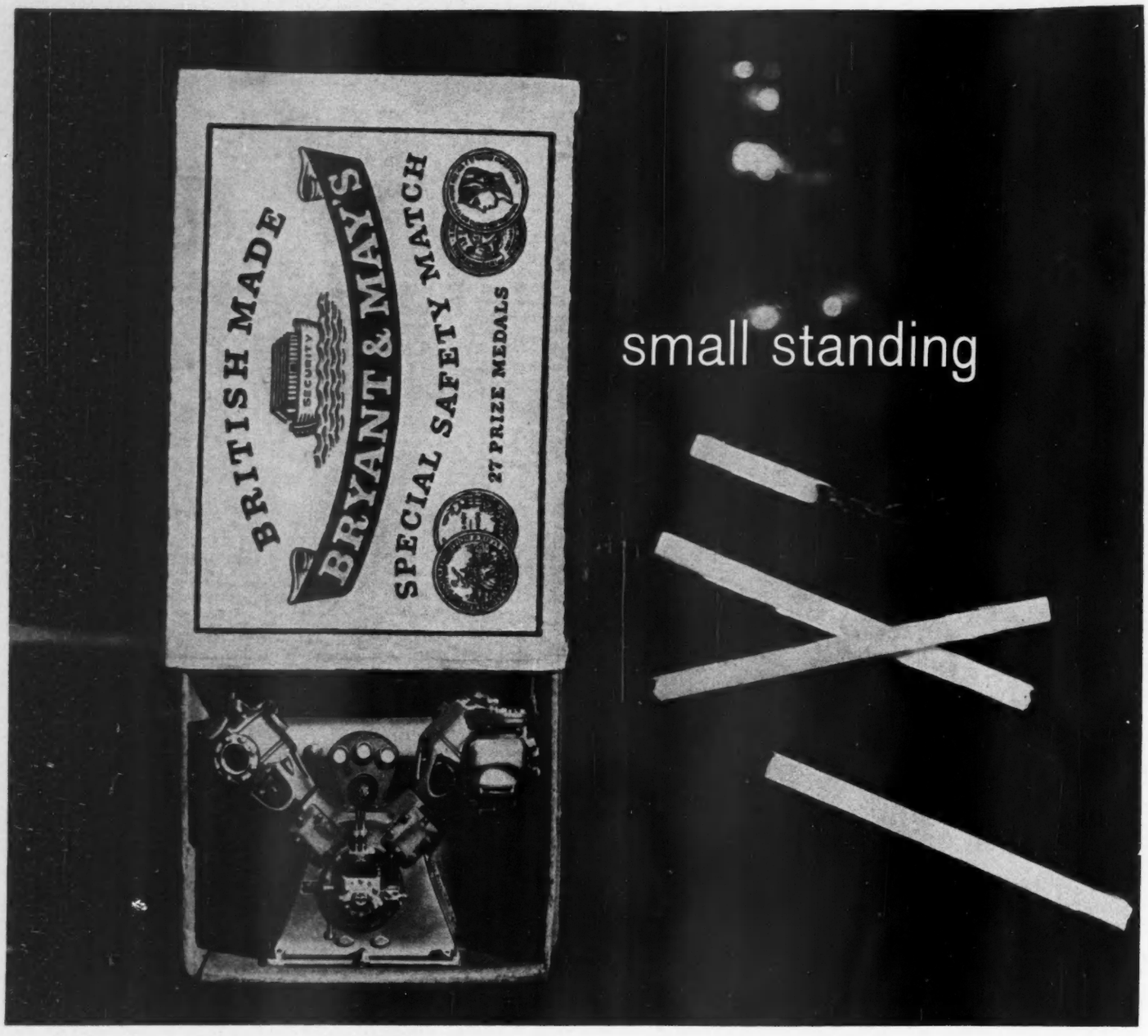


TABLE OF PROPERTIES

"Rendhex" Column No.	Size (Ins.)			Weight of Rolled Section lbs. per Lin. ft.	Weight of complete Col. (Incl. Weld) lbs. per Lin. ft.	Area of complete Col. (excl. weld) Sq. Ins.	Moment of Inertia (Ins.⁴)			Radii of Gyration (Ins.)			Section Moduli (Ins.³)		
	A	B	t				About XX	About YY	About ZZ	About XX	About YY	About ZZ	About XX	About YY	About ZZ
No. 3	13	12⅞	½	36·15	72.50	21·26	469·3	381·3	425·3	4·69	4·23	4·47	72.20	58·70	57·30
No. 4	16	16¼	⅝	58·30	117·75	34·30	1214	1038	1126	5·95	5·50	5·73	151·75	125·82	116·15
No. 6	20	20	0·7	80·70	162·80	47·47	2657·7	2203·5	2430·6	7·49	6·81	7·16	265·80	218·60	207·20



the Joy WN112 stationary compressor

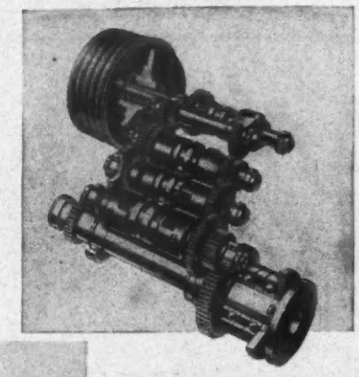
Exacts less space—extracts more power. Match it against any other two stage industrial air compressor. You won't find one combining Vee-twin construction, flange-mounted motor and small floor space requirements in such striking degree.

Small-standing, country-quiet, sentry-still JOY industrial compressors are fully described in publication AD/6. Please write for a copy.

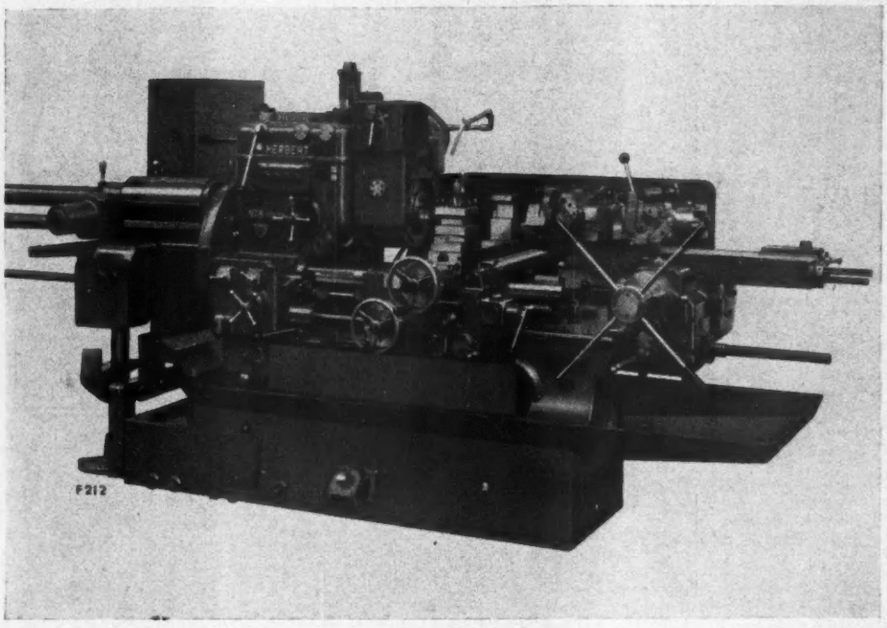
7 Harley Street, London W.1

AIR POWER
JOY-SULLIVAN LTD
DIVISION

every modern feature is incorporated to ensure high production, accuracy, durability, ease of operation on the



Shaft and gearing arrangement of power-operated Preoptive headstock. Hardened and ground gears close to bearings to minimise shaft deflection. All speed changes by multi-friction clutches. Multi-vee rope drive giving high efficiency.



HERBERT

No. 5 SENIOR PREOPTIVE CAPSTAN LATHE

The machine incorporates all the well-known Herbert Lathe features including the power-operated Preoptive Headstock. Automatic sliding and surfacing saddle with or without chasing and taper-turning attachments. Feeds to saddle reversible independently of those to the capstan slide. Chasing mechanism, when fitted, is automatically tripped.

Turret is automatically clamped at commencement of forward travel of the capstan slide and is of hollow construction. Leader control to capstan slide also available, if required. Supplied as a chucking (15½in. swing) or bar (2½in. dia.) machine, with hand, air or electric chuck.

Electrically-operated bar feed also available. 10 h.p. motor giving 16 speeds 21-1,500 r.p.m.

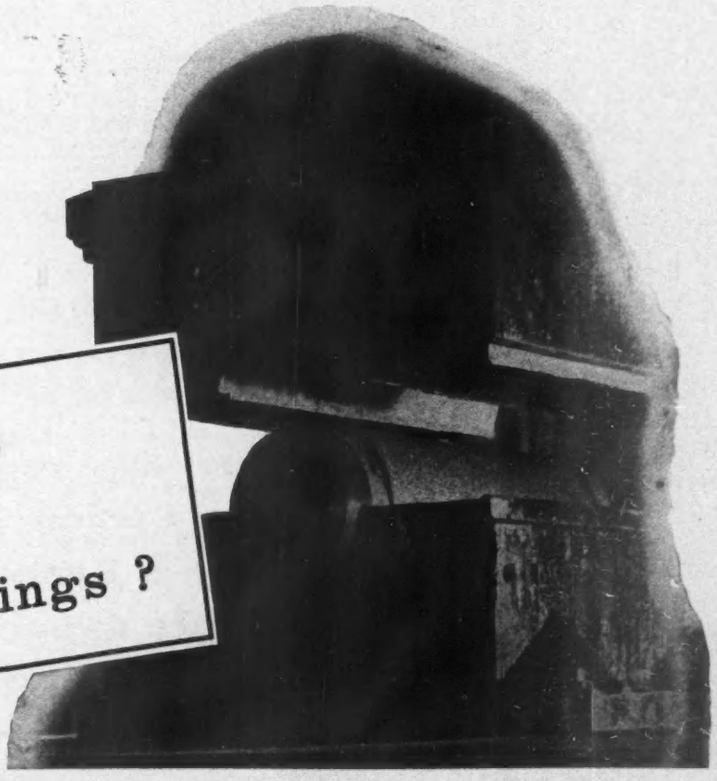
ALFRED HERBERT LTD., COVENTRY

A.D484

Lubricants for brake linings . . . ?

No, not really. But manufacturers of bearings made from resin-bonded asbestos — commonly used for brake linings — do incorporate "dag"* colloidal graphite in their products. Why? Because the fineness and stability of the particles in any Acheson dispersion ensure that the inherent properties of graphite are imparted to the material. Acheson dispersions may be impregnated or incorporated into fibres, leather, cloth, wood, paper and many other substances. "dag" colloidal graphite is heat-resisting, chemically inert, friction and therefore wear-reducing, electrically conducting and an excellent "parting" agent. These are the reasons why it is used extensively in industry as an integral part of, for instance, non-metallic bearings, packings, conducting textile tapes and braids, resistance heating panels of many types. If the possibilities interest you, write to the first and foremost manufacturers of colloidal graphite for specific recommendations.

lubricants for brake linings ?



Acheson Colloids LIMITED

subsidiary of Acheson Industries (Europe) Limited

50 YEARS

* Registered trade mark ACHESON

"dag" colloidal graphite is incorporated in the asbestos-type bearings manufactured at the High Wycombe Works of Railko Limited. One stage of production is illustrated.

P.O. BOX 12 · PRINCE ROCK · PLYMOUTH · DEVON Also ACHESON COLLOIDS CO., PORT HURON, MICHIGAN, U.S.A. & ACHESON COLLOIDEN N.V. SCHMEEDA (GR) NETHERLANDS

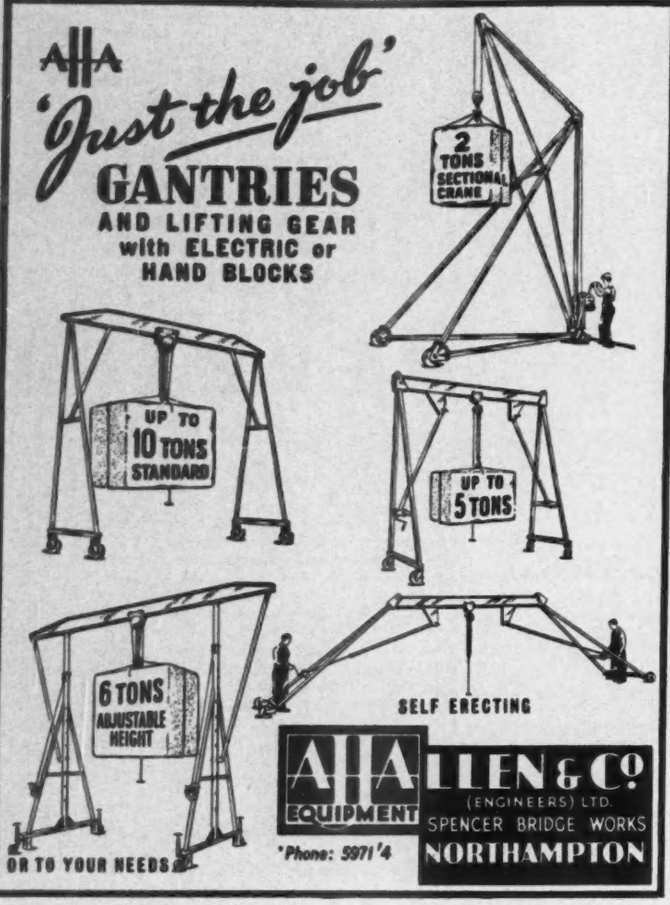
K

AIA

'Just the job'

GANTRIES

AND LIFTING GEAR with ELECTRIC or HAND BLOCKS



OR TO YOUR NEEDS

AIA EQUIPMENT

ALLEN & Co (ENGINEERS) LTD.
SPENCER BRIDGE WORKS
NORTHAMPTON

*Phone: 5971/4

The meaning of

SMITHS

in Production Planning

FOR IMMEDIATE DELIVERY

An hours counter gives you an exact record of running times of mains powered electric equipment or machinery. This enables you to apply planned maintenance schemes resulting in increased efficiency—and reducing production stoppages. For counting the hours fit a . . .

SMITHS Synchronous Counter

* 10,000 hrs Total Count; 1,000 hrs 'Trip' Count indicating in tenths can be included
* Pressed-steel case to withstand rough handling
* Precision-machined internal gearing for smooth running and self-starting
* High-torque, self-starting, synchronous 2-watt motor available for 50 or 60 cycle supplies of 12, 100/125, 200/250 V

Write now to:-

SMITHS INDUSTRIAL DIVISION

The industrial business of S. Smith & Sons (England) Ltd., including the marketing of industrial products under the trade marks of Smiths and Kelvin Hughes

Chronos Works, North Circular Road, London NW2 · Phone: GLA 1136

THE

GORDON

AUTOMATIC CONTROL SYSTEM

(PATENT APPLIED FOR)

DEVELOPED FOR

ONCE THROUGH BOILERS

Has met all expectations at the Maas Power Station, Roermond, Holland on a Benson Boiler

Our thirty years experience enables us to offer with every confidence the alternative

Pneumatic or Electronic

JAMES GORDON & CO. LTD

DALSTON GARDENS, STANMORE, MIDDLESEX

Forged steel rolls for all types of mills

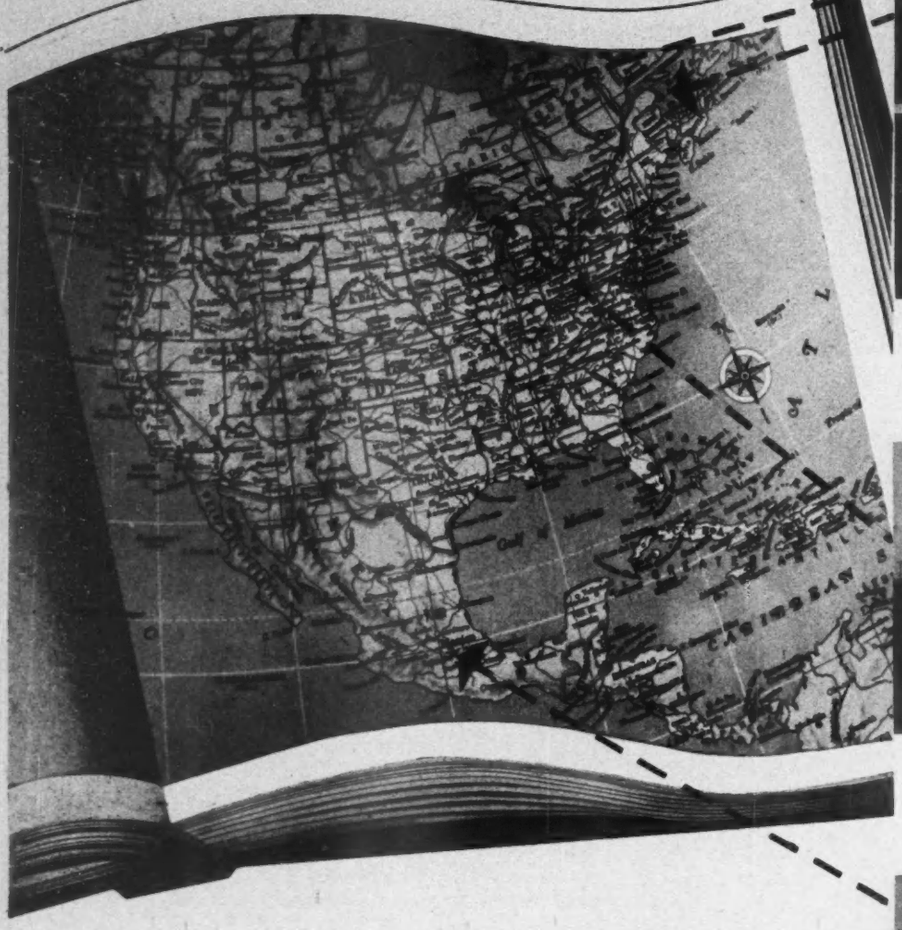
Whether required for the hot or cold rolling of ferrous or non-ferrous metals, or for use with non-metallic materials, Firth Brown can offer Forged Steel Rolls of the highest quality—particularly those of the fully hardened type.

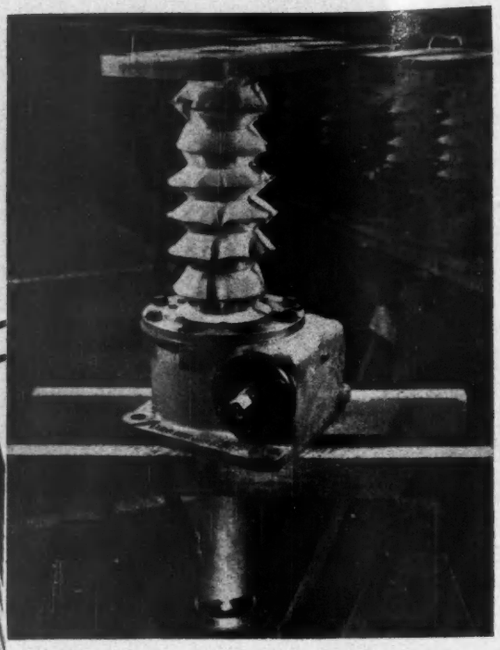
FIRTH BROWN

ALLOY STEELMAKERS · FORGEMASTERS · STEEL FOUNDERS · HEAVY ENGINEERS

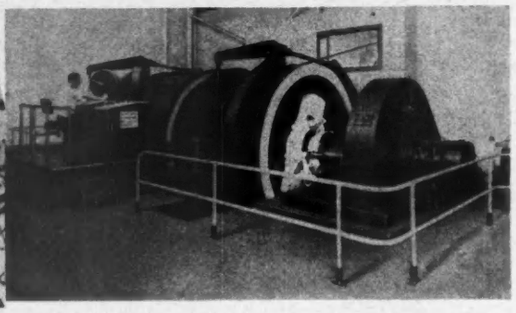
THOS FIRTH & JOHN BROWN LIMITED · SHEFFIELD · ENGLAND

GEARS FOR WORLD INDUSTRY

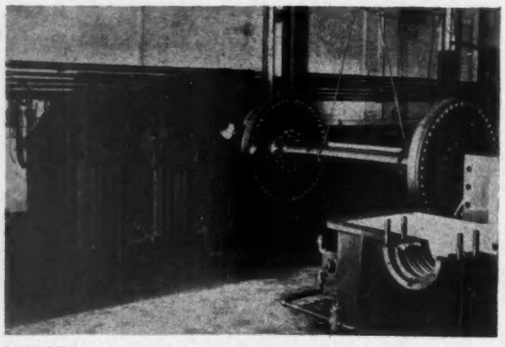




CANADA
Large numbers of these **25-ton** *jacks have been supplied for use on the smelters of the Aluminum Co. of Canada at Kitimat and the Canadian British Aluminium Co. Ltd. at Baie Comeau.*



CANADA.
Reduction gears of our manufacture are used in this mine hoist at Steep Rock Iron Mines. Acknowledgements to Canadian Ingersoll-Rand Co. Ltd.



MEXICO
An 800 h.p. double-reduction unit with torsion shaft and diaphragm couplings. Ten of these units have been supplied to a cement works in Mexico. Acknowledgements to Associated Portland Cement Manufacturers Ltd.

On the American continent, over a long period of years, equipment supplied by Turbine Gears Ltd. has played its part in the rapid expansion and progress of leading industries. Three examples are shown here, but they are only three of many installations with which we have been associated over the years.

From sugar-crushing to steel-rolling, from aluminium-smelting to atomic power production, industries of all types, supplying many needs call for high quality gears and gear units. In this field, the name of Turbine Gears Ltd. stands for long service and high efficiency.

Our staff of experts is ready at any time to help you with your gearing problems. Our comprehensive catalogue illustrates and describes the wide variety of our products and a copy will be gladly sent to you if you are interested.

GEARS AND GEAR UNITS BY **Turbine Gears Ltd**

STOCKPORT, ENGLAND.

TG.16

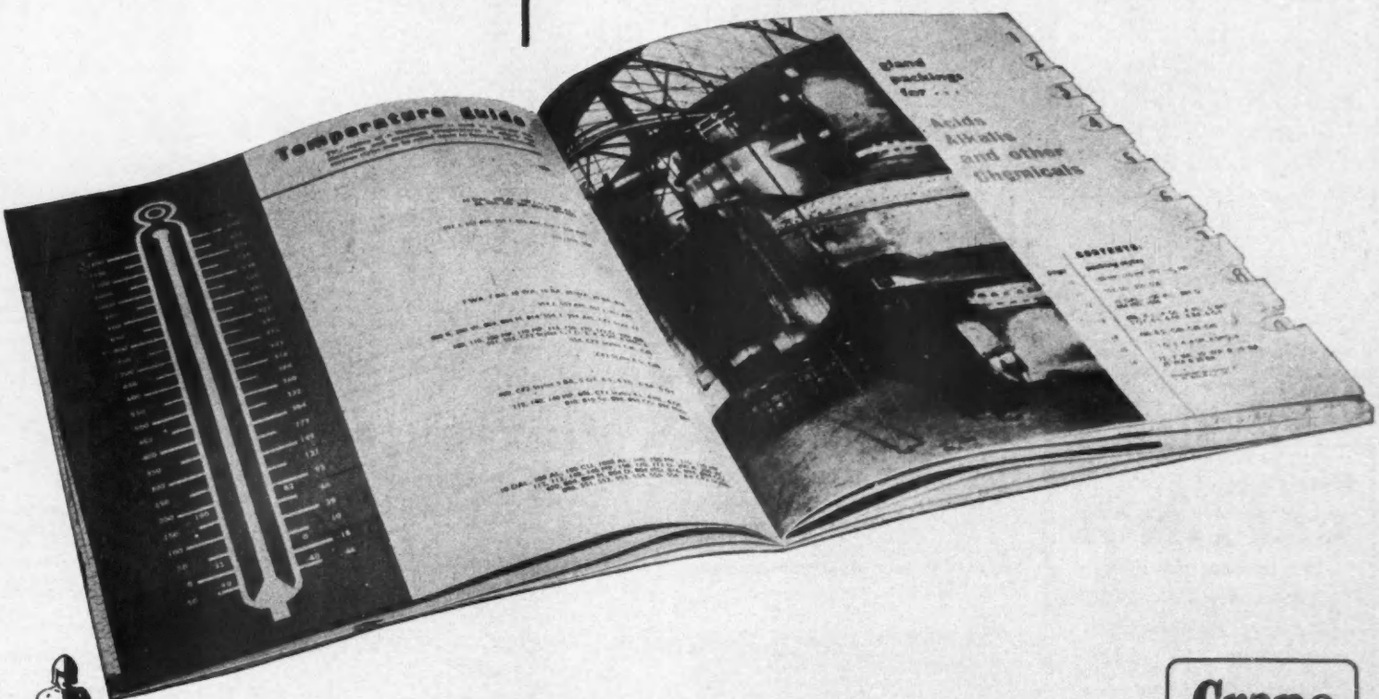
the book that has taken **thirty-five years** to produce

... it embodies the experience of 35 years as specialist manufacturers of gland packings.

Over the years we have produced a number of catalogues of our range of gland packings, each one more informative than its predecessor. **But this latest publication breaks entirely new ground.**

It is the most comprehensive reference book to the use of gland packings ever produced anywhere in the World.

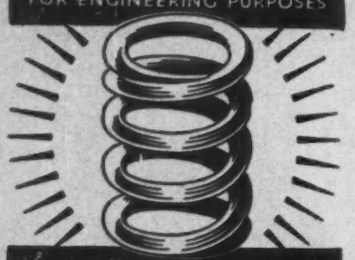
In the space available here it is impossible to describe all the contents, but we will send to you, *free of charge and postage paid*, a copy of the publication. **Please write to Crane Packing Limited, Gland Packings Division, Slough, Bucks.** *If you require the publication to be addressed personally to you, please let us have your name and address, the name of your Company and your position in the Company.*



ISSUED BY THE GLAND PACKINGS DIVISION OF

Crane Packing LTD OF SLOUGH ENGLAND A COMPANY

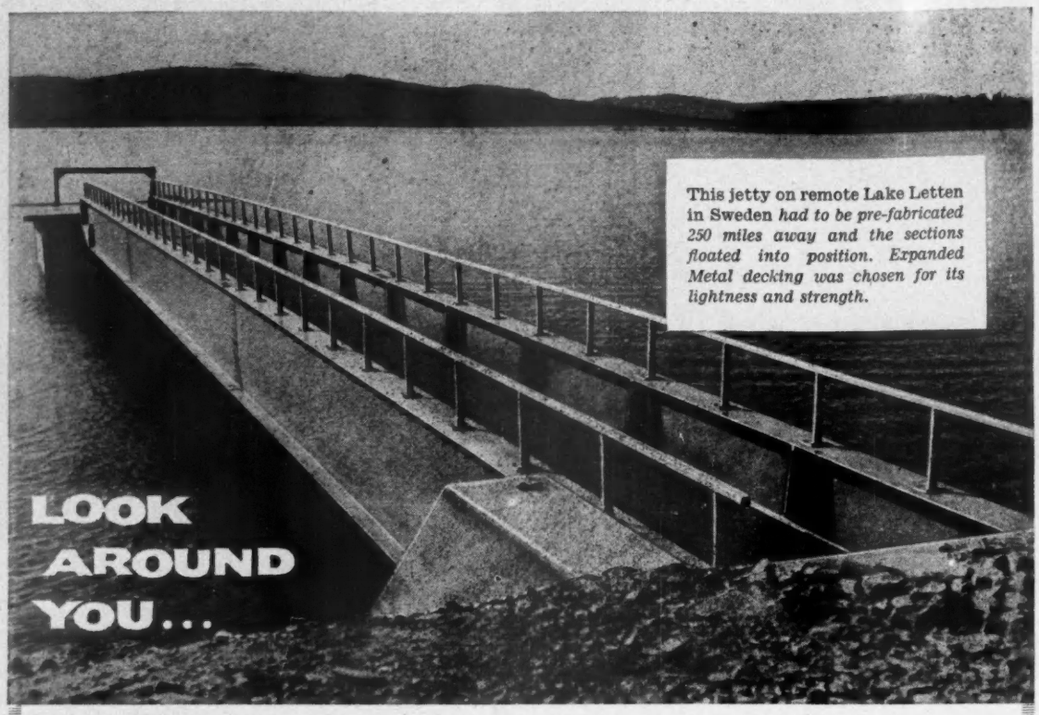
SPRINGS AND SPRING WASHERS
FOR ENGINEERING PURPOSES



Manufactured by
JOHN TONKS & CO LTD.
CENTRAL SPRING WORKS
Furnace Hill, SHEFFIELD, 3

CONVEYING & ELEVATING PLANT
CRUSHING, SCREENING and STORAGE MACHINERY
by
BARRY HENRY & COOK, LTD.
West North Street · Aberdeen
London Office: 28 Victoria Street, S.W.1

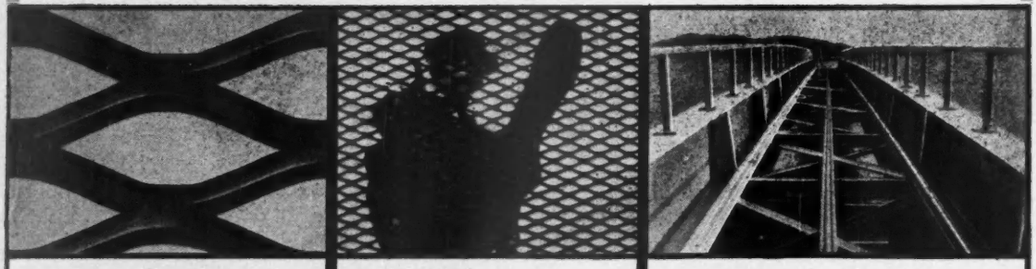
Quality
CASTINGS
We can supply High quality Iron Castings by modern processes to BSS 1452 all grades and up to 10 cwt per single casting
PATTERNSHOP FACILITIES IN FULL
HOCKLEY FOUNDRY
Co. Ltd.
HOCKLEY, ESSEX
Telephone London Victoria 7486
Hockley (Essex) 337



This jetty on remote Lake Letten in Sweden *had to be pre-fabricated 250 miles away and the sections floated into position. Expanded Metal decking was chosen for its lightness and strength.*

and see that on catwalks, walkways and decking Expanded Metal* provides the best solution at lower cost

* In steel or spark-free Aluminium



Expanded Metal is Lighter
Because of the exclusive way it is made, Expanded Metal is actually appreciably stronger than the solid sheet from which it is originally engineered.

Expanded Metal is Safer
Oily feet, icy feet, steel-shod feet . . . they're all safer on Expanded Metal's non-skid mesh that cannot clog or wear smooth beneath the march of time.

Expanded Metal Costs Less
The lightness of Expanded Metal enables you to specify lighter framing and support. It arrives on your site pre-fabricated for instant hook-bolting assembly . . . designed for your specific requirements.

Write today for details

EXPANDED METAL
at the heart of more things than most people realise

Expamet

THE EXPANDED METAL COMPANY LIMITED, 15 Caxton Street, London, S.W.1. Phone: ABBey 7766
Also at: Aberdeen · Belfast · Birmingham · Cardiff · Dublin · Exeter · Glasgow · Leeds · Manchester · West Hartlepool
The Expanded Metal Company of Canada Limited, Annacis Industrial Estate, Vancouver, Canada. *Agents and stockists throughout the free world*

BRITAIN'S SMALL NUCLEAR POWER STATIONS

AND

WORLD SURVEY OF REACTOR COMPANIES

Reprinted from 'Engineering' April 15, 22, and May 6, 1960

Price 4s. post paid from 'Engineering' 36 Bedford Street, London WC2

Free! Sample Tube of MOLYKOTE® G LUBRICANT

Industry's NEWEST Production TOOL

- ALMOST 100% SAFETY AGAINST GALLING AND SEIZING WITH ALL BEARING METAL COMBINATIONS
- ELIMINATES STICK-SLIP, METAL PICK-UP AND DISTORTION IN PRESS FITTING
- REDUCES WEAR-IN TIME AND DAMAGE IN NEW OR REBUILT MACHINERY
- THE HIGHER THE LOADS, THE GREATER THE MARGIN OF SUPERIORITY OF MOLYKOTE G

HIGHLY RECOMMENDED FOR:

- Threaded Connections
- Press Fitting
- Splines
- Highly-Loaded Gears
- Chucks & Collets
- Packings
- Drills, Taps & Dies
- Universal Joints
- Rod End Bearings
- Cams
- Dies & Punches
- Guide Posts

Write for your free sample of MOLYKOTE G LUBRICANT today. We will also send you a copy of our new Bulletin 126 which gives complete details.

AFSA LTD. 25, VICTORIA ST., LONDON S.W. 1

Please send me a free sample of your MOLYKOTE G Lubricant.

NAME _____

TITLE _____

COMPANY _____

_____

ADDRESS _____

CITY _____

AFSA LTD.
25, Victoria St., London S.W. 1

absterge
(to clean by wiping)

Austins supply the best cleaning rags for every purpose. Some jobs called for coarse, heavy fabric, some for soft, closely woven materials—we can meet all requirements with carefully selected rags that are thoroughly washed and sterilized in our own plant. Orders of all sizes are handled with promptness and reliability. Please let us quote you for regular supplies.

AUSTINS industrial cleaning rags

E. AUSTIN & SONS (LONDON) LTD., GUN WHARF, GUNMAKERS LANE, E.3 · Tel: ADVance 1211

Valves, Cocks & pipe line fittings from Stock

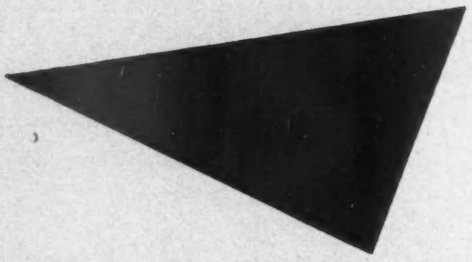
PEGLER & LOUDEN LTD

54 BROWN STREET	113 NEW BRIDGE STREET	87 SHAW STREET
GLASGOW	NEWCASTLE	LIVERPOOL

but the STEEL-SHAW COUPLING can take it!

Here's a really **flexible** coupling. Its individual springs mean that it will accommodate alignment errors; absorb shock and stress; damp out vibrations yet allow free end-float under loads; have a resistance to shear of approximately fifteen times the working load. Yet when you come to look at sizes against torque, you'll find that this outstanding unit will be smaller in diameter than any other coupling you can buy. *Write for full details today.*

STEELE & COWLISHAW LTD.
NEARLY HALF A CENTURY'S EXPERIENCE IN MIXING
COOPER STREET · HANLEY · STOKE-ON-TRENT
Telephone: STOKE 23333 (5 lines) TELEX 3630
A MEMBER OF THE BAKER PERKINS GROUP



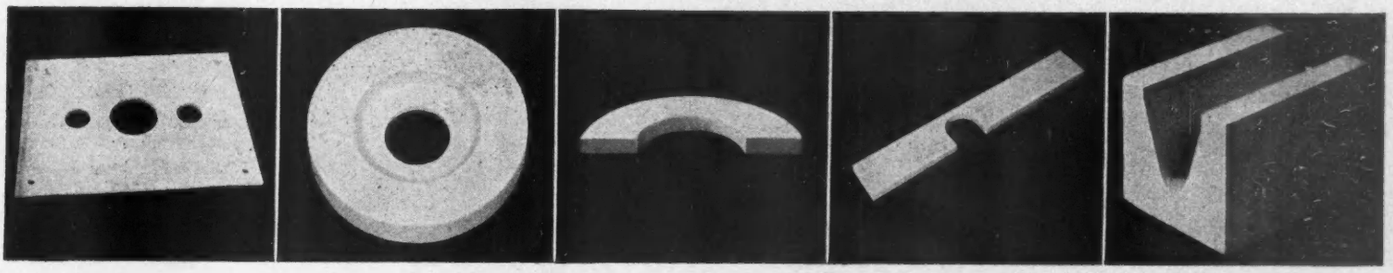
No Guesswork

at Colneside Works, West Drayton. Control of noise is an exact Science these days—we know because we practise it. Few Architectural or Industrial noise problems now exist for which an acoustically correct solution cannot be found. We know because we find them—and what is more, we warrant the results. Yet how many of our otherwise enlightened Architects or Industrialists know this simple truth, or realise just how much modern Acoustic Engineering can in fact achieve? Do you? If you are saddled with a noise problem and we of Sound Control Limited, at West Drayton, 3685, are sitting on the answer, why read further?

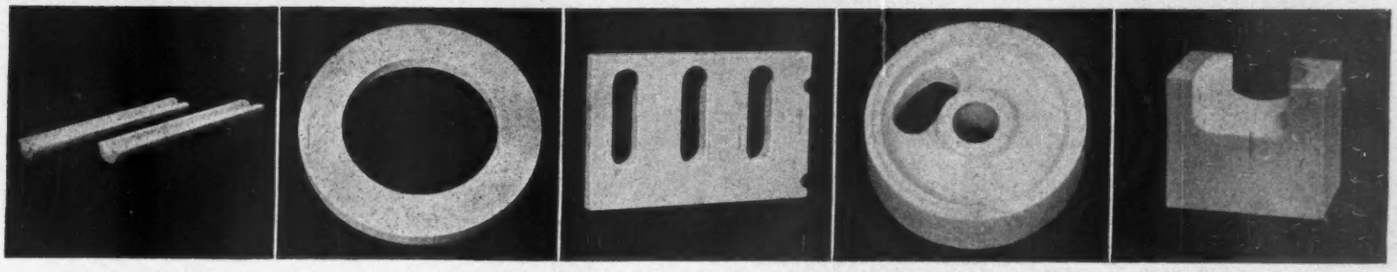
A Member of the Hall—Thermotank Group

Each one of the objects
in this photograph is a machine part
from which is required a
specialised performance
combining:

Rigidity
Strength
Low thermal capacity
Non-combustibility
Chemical inertia
Machinability



we call them "specials"



Each has been machined in our factory
from flat Marinite sheet (up to 4 ins thick)
to a drawing provided by the user

can we turn one out for **you**?

MARINITE

25 & 27 North Row, London W.1

Telephone: GROsvenor 5115. Telex: Incorrupt London

TA 8699

PACKAGED escalators

from J. & E. Hall

The only British-built packaged escalator, constructed by the largest manufacturers of escalators for stores, commercial and public buildings, and backed by 30 years' experience.

Passes throught 10 ft. opening, cuts actual installation time to approximately 3 days, and ensures the minimum of interruption to normal business arrangements.

J. & E. Hall's escalator engineers are at all times at your service to discuss all aspects of escalator planning, installation and operation.

J & E HALL LTD

A Member of the Hall-Thermotank Group

DARTFORD · KENT Tel: Dartford 23456

London Office :

10 St. Swithin's Lane, E.C.4. Tel: MANsion House 9811

Pneumatic conveying

cement, flour, cereals, sugar, sand, etc.

Thousands of Godfrey blowers are in service in pneumatic conveying systems throughout the world. These blowers are simple, compact and reliable in service. Illustrated are three models from the range available with typical performance details in actual applications.

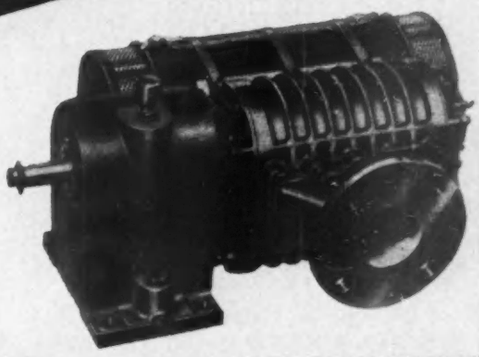
GODFREY
SIR GEORGE GODFREY & PARTNERS (IND) LTD.

K-200 (air slide)

Speed rpm	Airflow cfm	Pressure psi
1500	75	2
3000	150	7

K-300

Speed rpm	Airflow cfm	Pressure psi
1500	100	5
2900	200	10



L-675

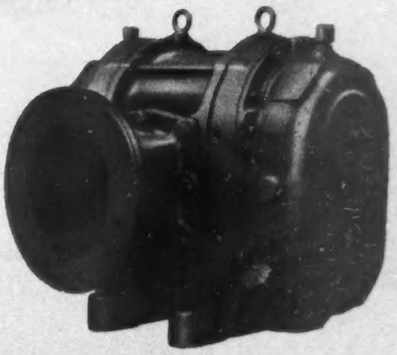
Speed rpm	Airflow cfm	Pressure psi	
1500	100	5	*
2750	450	10	*
1500	200	5	†
2750	400	12	†

* available with 2 : 1 step up gear

† carbon seals, continuous duty. Also available for pressures up to 15 psi, intermittent duty.

M-2000

Speed rpm	Airflow cfm	Pressure psi
1500	750	3
2200	1000	10



SIR GEORGE GODFREY & PARTNERS (INDUSTRIAL) LIMITED

HANWORTH · MIDDLESEX

Telephone : FELtham 3291 Cables: Godfrepart, London

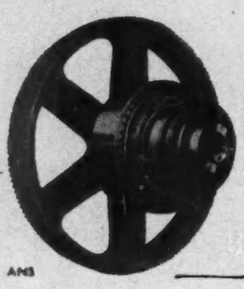
ASSOCIATED COMPANIES: MONTREAL, MELBOURNE AND JOHANNESBURG

TAYLOR INDUSTRIAL CLUTCHES

1 h.p. to 500 h.p.

A STEP FORWARD IN CLUTCH DESIGN

★ The most Universal Clutch for every type of friction drive.
★ The most extensively used.
★ 30 years of intensive specification.
★ The most successful in both performance and durability.
★ Mechanical, Pneumatic and Hydraulic types.



TAYLOR INDUSTRIAL CLUTCHES
TROWS UPPER WORKS
CASTLETON · LANCS
Phone 57630 CASTLETON ROCHDALE

ANS

THE NEWBURY DIESEL Co. Ltd.
NEWBURY - ENGLAND

For

MARINE
DIESEL ENGINES
UP TO 1600 H.P.

ELTRON for ELEMENTS

FOR
AIR, OIL or WATER
INFRA-RED or OVEN HEATING

●

ELTRON (LONDON) LTD.
Strathmore Road · Croydon
Telephone: Thornton Heath 1861

ROBSON CONVEYORS
ESTABLISHED 1906

10 TON
ROLLER TURNTABLE

Geo. ROBSON & CO. (CONVEYORS) LTD.
HODGSON STREET · SHEFFIELD.
PHONE. SHEFFIELD. 27463/4

BECAUSE
NOTHING
ELSE
WILL DO

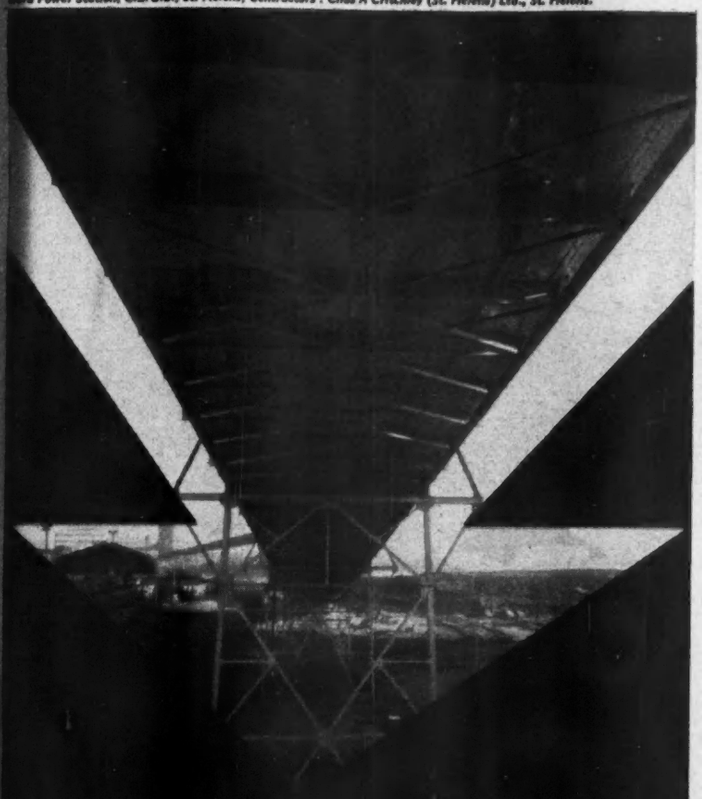
Sooner or later you'll meet up with it—perhaps you have already—the connection that only Plessiflex can make!
The moment of recognition is instantaneous.
It comes when you are faced with apparently insurmountable problems of vibration, misalignment, corrosion, and extremes of temperature or pressure.
Should you not already be fully acquainted with the outstanding characteristics of Plessiflex, you will find Publication No. 1121 to be very enlightening.

POWER AUXILIARIES LTD
Kembrey Street
Swindon · Wilts
Tel: Swindon 6211

Overseas Sales Organisation:
Plessey International Limited, Ilford, Essex
Telephone: Ilford 3040

PAL 18A

Bold Power Station, C.E.G.B., St. Helens, Contractors: Chas A Crichley (St. Helens) Ltd., St. Helens.



Prevent CORROSION

Zinc Chromate Primer and Epilux 1 — two outstanding anti-corrosive coatings already widely used throughout industry — protect steelwork at Bold Power Station.

ZINC CHROMATE PRIMER: A water-resisting medium, ensures maximum defence against corrosion on non-ferrous metals. Cheaper than red lead, it spreads further and more easily, dries faster and harder: good storage life, easy to mix. In yellow, green and red.

EPILUX 1: This air/drying enamel is based upon Epoxy resins. It possesses remarkable flexibility and abrasion resistance. In addition Epilux 1 has shown exceptional ability to withstand the attack of alkalis and mild acids . . . good resistance to water, excellent adhesion. Superior to traditional gloss paints in heavily chemical laden atmospheres.

ZINC CHROMATE PRIMER

EPILUX 1

BRITISH PAINTS LIMITED

Industrial Maintenance Division

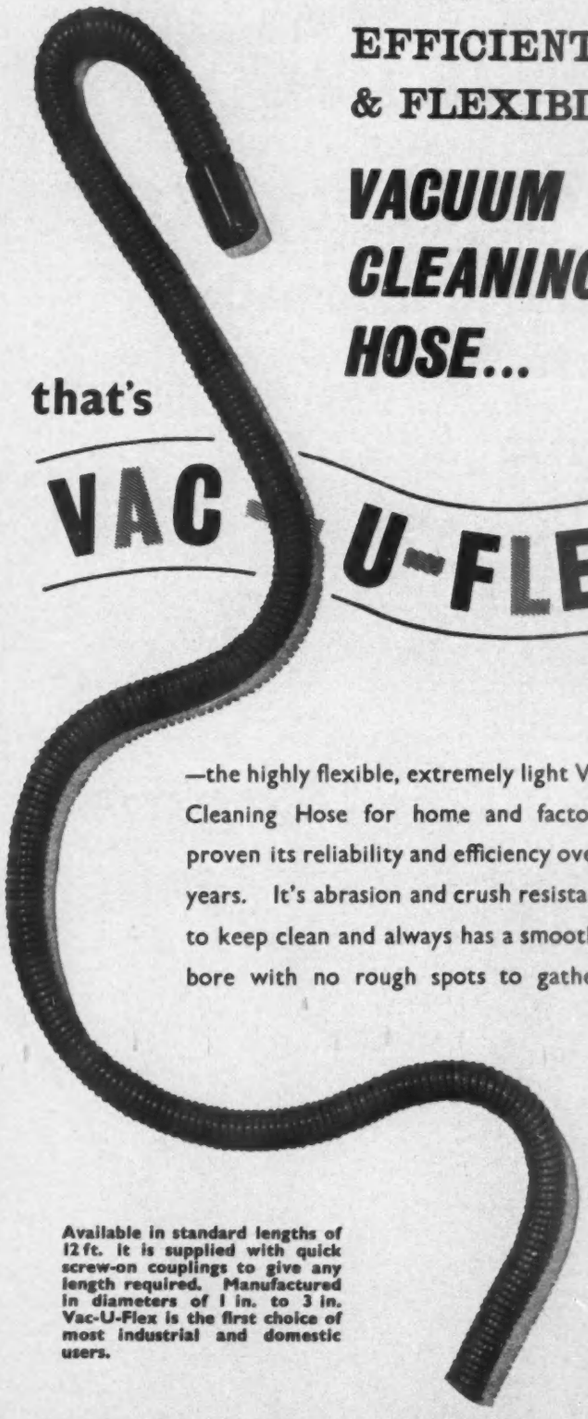
PORTLAND ROAD, NEWCASTLE UPON TYNE, 2. NORTHUMBERLAND HOUSE, 303-306, HIGH HOLBORN, LONDON, W.C.1. 31, WAPPING, LIVERPOOL, 1.

Belfast, Birmingham, Bristol, Cardiff, Glasgow, Leeds, Manchester, Norwich, Plymouth, Sheffield, Southampton, Swansea, and all principal towns.

STILL THE WORLD'S MOST EFFICIENT & FLEXIBLE

VACUUM CLEANING HOSE...

that's VAC-U-FLEX REGD.



—the highly flexible, extremely light Vacuum-Cleaning Hose for home and factory, has proven its reliability and efficiency over many years. It's abrasion and crush resistant, easy to keep clean and always has a smooth inside bore with no rough spots to gather dirt.

Available in standard lengths of 12 ft. it is supplied with quick screw-on couplings to give any length required. Manufactured in diameters of 1 in. to 3 in. Vac-U-Flex is the first choice of most industrial and domestic users.

FLEXIBLE DUCTING LTD.

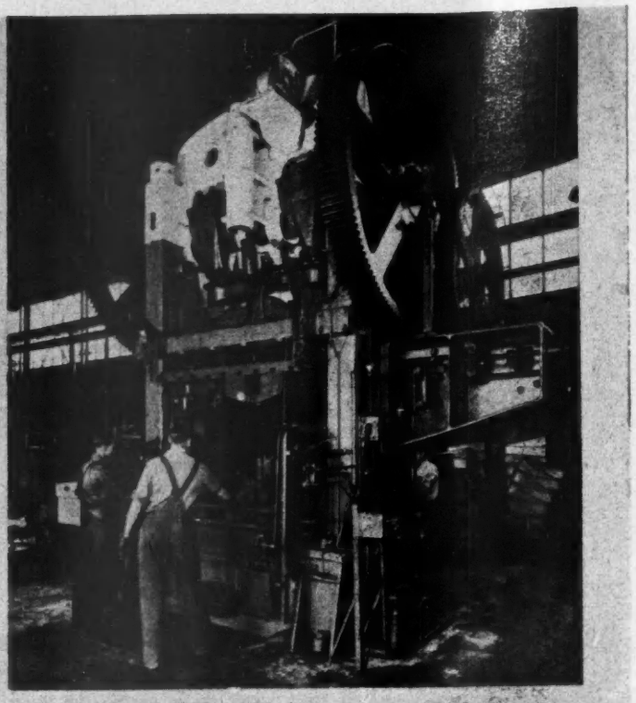
SHUNA STREET, MARYHILL

GLASGOW, N.W.

Telephone: MARyhill 3311

Telegrams: FLEXIDUCT, GLASGOW, N.W

Ross Air Valves for RELIABILITY



Reliable Automation

BY PNEUMATICS, MEANS

ROSS

AIR CONTROL VALVES

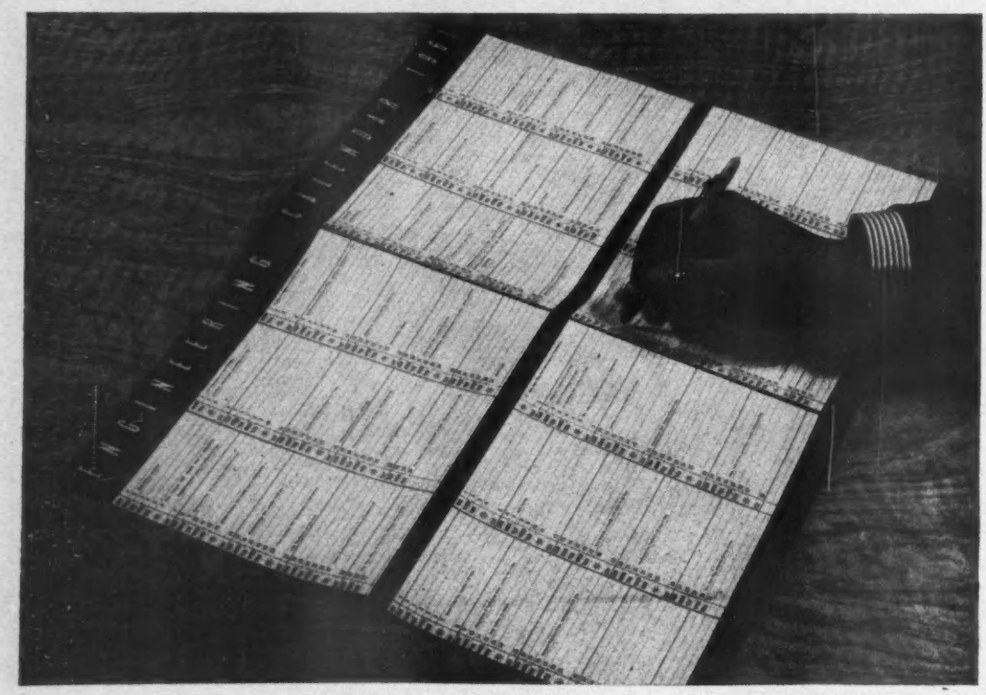
Messrs. N. C. Joseph Ltd., Stratford-upon-Avon, manufacturers of 'Sona' Aluminium Household Ware, Steel Pressings, etc., re-equipped the press illustrated for 'All-Air' Control with Ross Air Valves in June, 1956. The press has since been in constant production, the valves having operated without fault or maintenance.

SEND NOW FOR CATALOGUES FROM :—

THE WELLMAN SMITH OWEN ENGINEERING CORPORATION LTD

PARNELL HOUSE, WILTON ROAD, LONDON, S.W.1 WORKS: DARLASTON, South Staffs, & BELFAST.

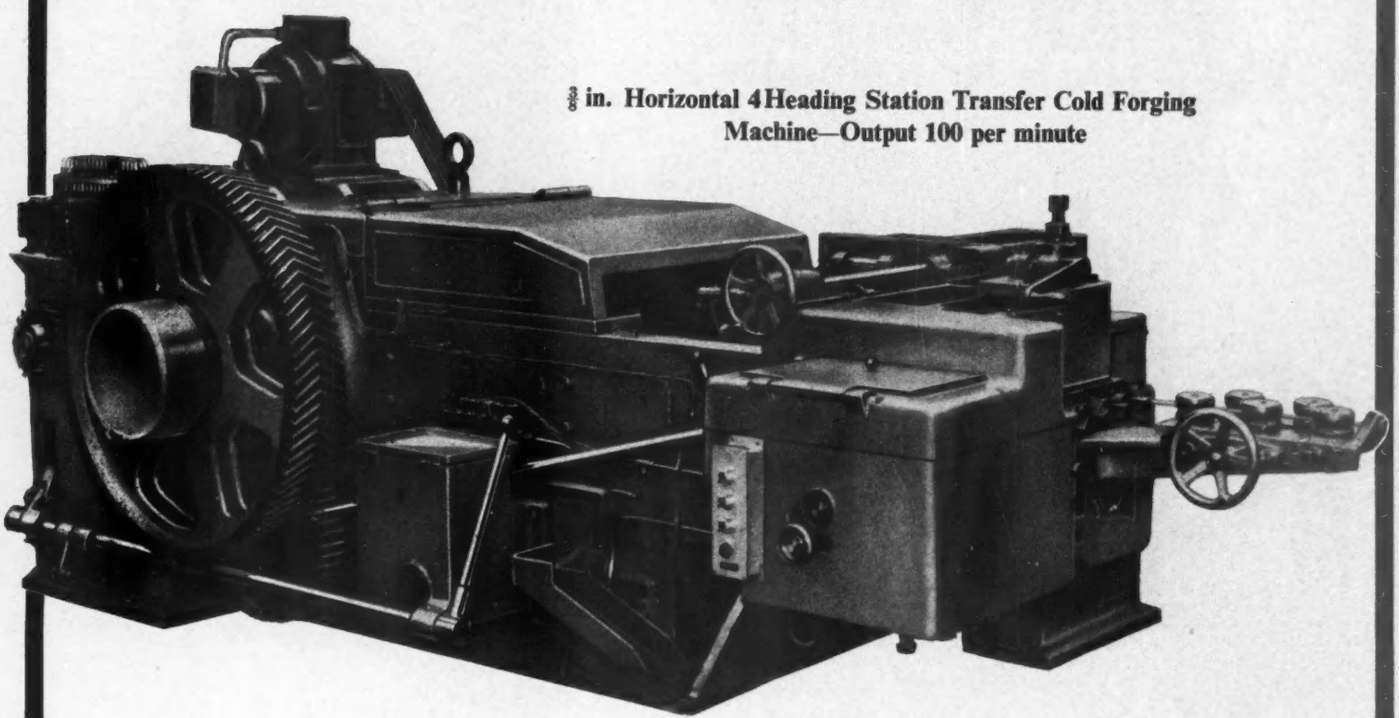
'Engineering' Calendar 1961



With a whole year on one page, this is an ideal *planning* calendar ; it also reminds you of the *main events* of 1961 of interest to engineering firms and their overseas connections. Additional events of special interest to you can be recorded from the weekly 'Events in Advance' feature published in 'Engineering'. Copies of this calendar are available *gratis* from

ENGINEERING, SUBSCRIPTION DEPARTMENT, 36 BEDFORD STREET, LONDON, WC2 (TEL.: TEMPLE BAR 3663)

GREENBAT COLD FORGING MACHINERY



⅜ in. Horizontal 4 Heading Station Transfer Cold Forging Machine—Output 100 per minute

This ⅜in. Horizontal 4 station transfer Cold Forging Machine has an output of 100 per minute. It will cut off lengths of 4½in. with a cut-off capacity of 9/16in. diam. on High Tensile steel wire. Special features include the punch and die ejectors, fitted with electrical safety devices so that in the event of a tooling failure the machine is stopped almost instantaneously by motor plug brakes working in conjunction with a powerful band brake. The machine is fully automatically lubricated and can be supplied with a variable speed drive.

Also available is a complete range of standard and high speed, single and double blow, open and solid die cold forging machines; reheading and trimming machines; thread rolling machines, etc.

Advice willingly given on any manufacturing problems connected with cold or hot forging.

GREENWOOD & BATLEY LTD.

ALBION WORKS LEEDS ENGLAND

A Naphthalene Dehydration Vessel of 7,500 gallons capacity, 12 ft. in diameter. Like many supplied by Millspaugh this vessel was subjected to rigorous interstage examination by our clients' appointed inspectors.

BIG FELLOW!

Size *is* important at Millspaugh and fabrications like this 7,500 gallon Naphthalene Dehydration Vessel come pretty often. But quality is the main concern at Millspaugh and some of the most modern and thorough inspection and testing equipment in the country relentlessly makes sure that a Millspaugh Fabrication is one to be relied upon, whichever end of the scale it is—giant size, or relatively small.

WELDING AND FABRICATIONS BY **MILLSPAUGH SHEFFIELD**

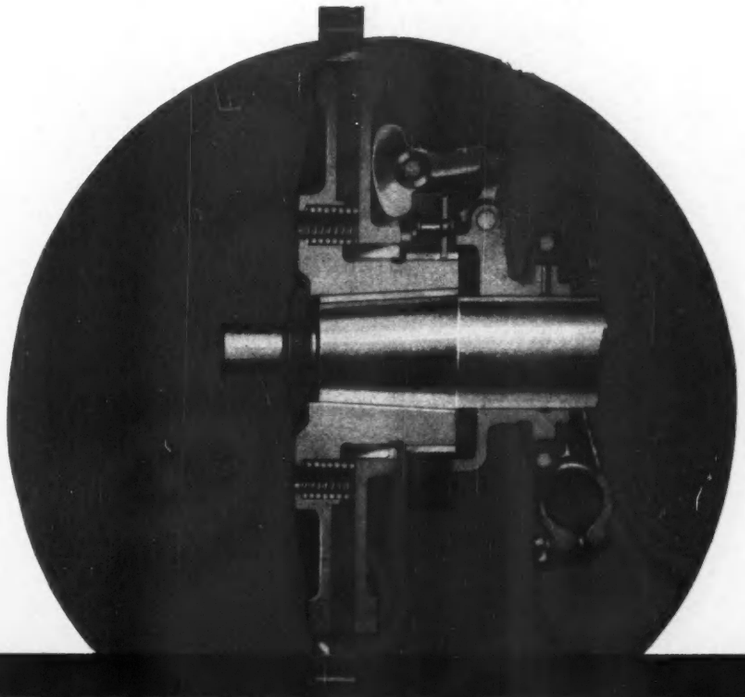
MILLSPAUGH LIMITED, ALSING ROAD, SHEFFIELD 9.
Tel: 42411 (5 lines). Telex. 54-107

LONDON OFFICE: 25, BERKELEY SQUARE, W.1.
Telephone: HYDe Park 0431.

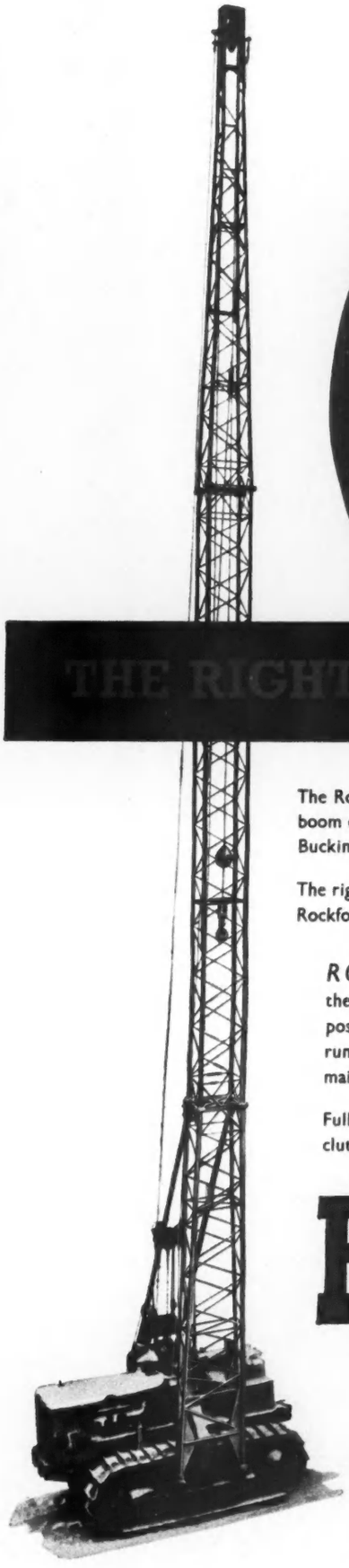
MEMBER OF THE HADFIELDS GROUP

• LONDON • PARIS • ROUEN • MONTREAL • OWEN SOUND •

Printed by HARRISON & SONS, LTD., by Appointment to H.M. The Queen, Printers, London, England. Published by ENGINEERING LTD., at 136 Bedford Street, London, W.C.2



THE RIGHT CLUTCH FOR THE JOB



The Rockford 11½" single plate over-centre clutch unit is used in the striking side boom equipment (left) made by T. T. Boughton & Sons Ltd., Amersham Common, Buckinghamshire, and installed on a Fowler Challenger 33 Tractor.

The right-hand illustration shows a Caterpillar D.8 Tractor, also fitted with an 11½" Rockford clutch unit and T. T. Boughton side-boom crane attachment.

ROCKFORD FEATURES Being an over-centre type, the Rockford clutch is held positively in the engaged or disengaged position; when being operated the thrust is momentary, and in the running position end thrust is avoided. Easily adjusted; easily maintained. Made in an extensive range of sizes etc.

Full particulars on application of Rockford products and Borg & Beck clutches.

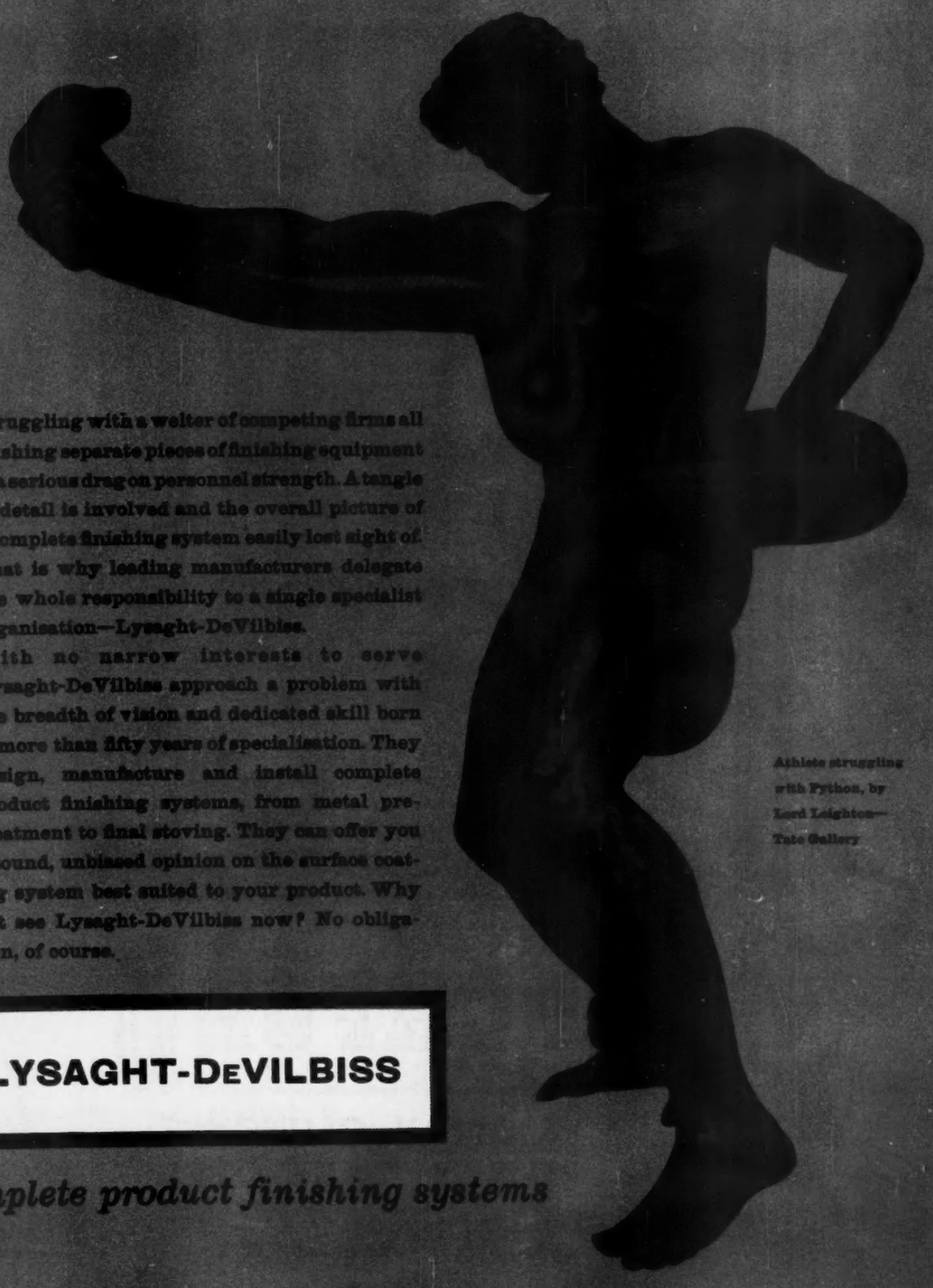
ROCKFORD

FRICTION CLUTCHES
POWER TAKE-OFFS

BORG & BECK COMPANY LIMITED
LEAMINGTON SPA, WARWICKSHIRE, ENGLAND

ONE OF THE AUTOMOTIVE PRODUCTS GROUP

The art of disengagement



Struggling with a welter of competing firms all pushing separate pieces of finishing equipment is a serious drag on personnel strength. A tangle of detail is involved and the overall picture of a complete finishing system easily lost sight of. That is why leading manufacturers delegate the whole responsibility to a single specialist organisation—Lysaght-DeVilbiss.

With no narrow interests to serve Lysaght-DeVilbiss approach a problem with the breadth of vision and dedicated skill born of more than fifty years of specialisation. They design, manufacture and install complete product finishing systems, from metal pre-treatment to final stoving. They can offer you a sound, unbiased opinion on the surface coating system best suited to your product. Why not see Lysaght-DeVilbiss now? No obligation, of course.

Athlete struggling with Python, by Lord Leighton—Tate Gallery

LYSAGHT-DEVILBISS

complete product finishing systems

LYSAGHT-DEVILBISS DIVISION OF JOHN LYSAGHT'S BRISTOL WORKS LTD 47 HOLBORN VIADUCT LONDON EC1
TEL: CITY 4361

TA 8961